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THE SHARKS OF CALIFORNIA.

By EDWIN CHAPEN STARKS, Stanford University.

Now that the conservation of food is a matter of public interest it seems a propitious time to call attention to the great amount of possible food that we allow to go to waste in the sharks and skates. In Europe nearly all of the fishes of this group command as high a price in the market as do other coarse fishes. The writer has eaten several species of them in Italy and France, and though they can not compare with our fine-fleshed, delicately-flavored fishes, they do compare very well with many of our fishes and excel some of our coarser ones that we use in abundance.

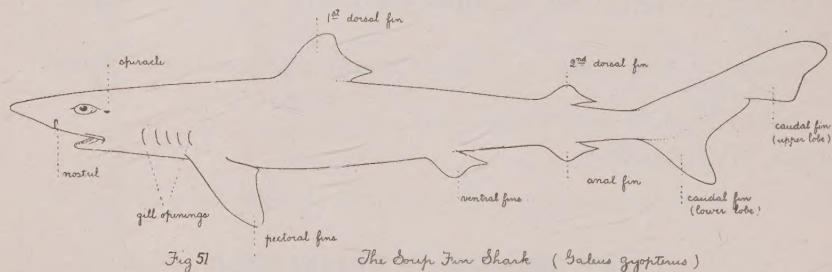
We are just beginning to use and appreciate the grayfish, but most species, if not all, of this group are edible to judge by Mediterranean markets. Doubtless experimenting would show us that some of the sharks and skates are very good, and some, perhaps, so coarse and ill-flavored that we would not use them at all.

By causing a market demand for these fishes we should not only introduce a cheap fish food, but by reducing their number we should save many better fishes, as well as clams and oysters, of which sharks and skates eat great quantities, destroying thousands of dollars worth

of valuable food every year. They are counted as pests by the fishermen, for they not only take bait intended for marketable fishes, but they tangle and destroy the fishing gear.

Sharks and skates are the oldest and most widely distributed of the fishes. They have no bones, the skeleton being entirely of cartilage. They have no true scales, but are naked, or more usually covered with fine, sharp prickles, so that the skin resembles sandpaper. In fact, at one time sharkskin was used by cabinetmakers as they now use sandpaper. These fishes usually have five gill openings, though some forms have six or seven. Two of these exceptions we have on our coast. The tail fin is uneven, the "backbone" extending into the upper part of it, which is longer than the lower part, or it may extend in a whip-like organ in some skates. In the male a tube-like reproductive organ is developed on the hinder margin of each ventral fin. In all of our species the mouth is on the lower surface of the head with the snout extending over it. In some forms the eggs are hatched within the body and the young brought forth alive. In others the eggs are deposited on the sea bottom, where they remain uncared for until they hatch.

In the following account the sharks only are considered; the skates, which are closely related to them, being reserved for a future article. The characters here given will serve, it is hoped, to identify all of our



sharks, but it will be necessary to learn the names of the fins and a few other things as given in figure 51.

1. THE COW SHARK (*Notorhynchus maculatus*) may be known from all others on our coast by its seven gill slits. It is sandy gray in color and has small black spots scattered over it. This species and the next have only one dorsal fin. It is not very uncommon and is known along the entire coast from San Diego to Puget Sound.

2. THE SHOVEL-NOSED SHARK (*Hexanchus griseus*) may be known from all others by its six gill slits. It is dark gray in color. It is widely distributed, being known from Scotland, the Mediterranean, the West Indies and northward on our coast to Puget Sound. It reaches a length of twenty-five feet. This shark must not be confused with the skate (guitar fish) known in southern California as the shovel-nosed shark.

3. THE BULLHEAD SHARK (*Heterodontus francisci*) is the only shark in our region that has a spine at the beginning of each dorsal fin and an anal fin in addition (see fig. 52). Another shark has dorsal spines but lacks an anal fin. This shark, as well as the shovel-nosed and cow shark, is interesting from the fact that its near relatives lived in early geologic

ages and it has changed but little from them. It is rather common on the southern California coast and does not grow to be over two or three feet in length. Above each eye is a high ridge, giving the animal

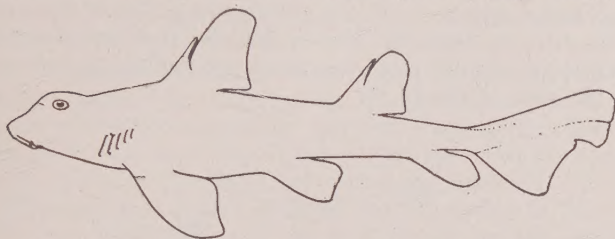


Fig 52

The Bullhead Shark (*Heterodontus francisci*)

a rather bizarre appearance. It is brown in color and has small black spots scattered over it. It feeds on crabs and clams which it crushes between its blunt molar-like teeth. The egg cases of this shark are often picked up on the beaches. They are conical, leather-like, and have a thin ledge arranged spirally around the outside, giving them a twisted appearance.

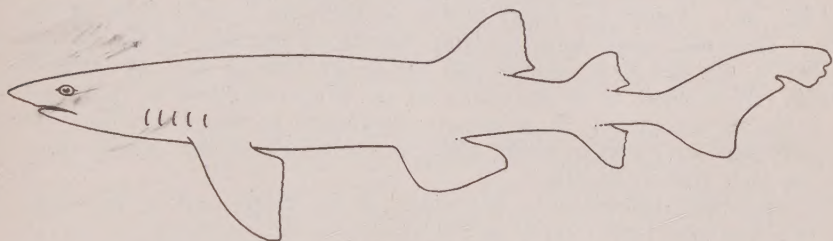


Fig 53

The Swell Shark (*Catulus uter*)

4. THE SWELL SHARK (*Catulus uter*) may be known by its having an anal fin and in addition the first dorsal not in front of the ventrals (see fig. 53). Two other species of *Catulus* are found on our coast, but they are very rare and found in deep water, and are little apt to be seen, therefore they are not included here. They, too, have the above combination of characters, but the swell shark differs from them in having the distance from the tip of the snout to the edge of the upper lip just a little greater than the long diameter of the eye. It is grayish and tinged with yellow below, while dark crossbars are on the back. Blended dusky-brown spots are scattered over the body. The swell shark is about three feet in length at full size and is found from Monterey Bay southward to San Diego. It is abundant in the Santa Barbara Channel and is often taken in the lobster pots set for the spiny lobster. It gets its name from its habit of swelling itself up with air when it is taken from the water.

The following six genera all belong to one family: *Mustelus*, *Triakis*, *Galeus*, *Galeocerdo*, *Prionace*, and *Carcharinus*. We shall first give the characters that separate the family as a whole from our other sharks

and under each species the characters that will separate it from others of the family.

The first dorsal entirely in front of the ventrals; second dorsal opposite to the anal; no dorsal spines; the last gill opening above the base of the pectoral; eyes with an inner eyelid; an anal fin present; a notch below the tip of the upper caudal lobe; the head not mallet-shaped nor the tail as long as the rest of the body.

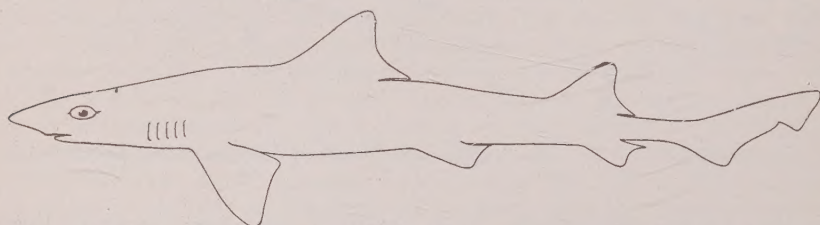


Fig 54

Smooth Hound (*Mustelus californicus*)

5. THE SMOOTH HOUND (*Mustelus californicus*) may be known by its small, blunt, pavement-like teeth arranged in oblique rows; even by the aid of a magnifier no point appears on the teeth as in the next species (see fig. 54). When the point of the pectoral fin is held close to the body it does not reach past the front fourth of the base of the dorsal. Neither it nor the next species has the lower lobe of the caudal projecting. This shark is as abundant on the southern coast as the gray-fish is on the northern. It is known northward to San Francisco. It is a uniform lead color, growing white below, and does not exceed three and one-half feet in length.

The apparent difference in the shape of the front part of the head between *Mustelus californicus* and *Mustelus henlei* shown in the drawings of these two species is brought about by the former having been made from a photograph, which shows perspective, while the latter is, as usual, drawn like an architect's plan, without perspective. There is little or no real difference in this respect between the two.

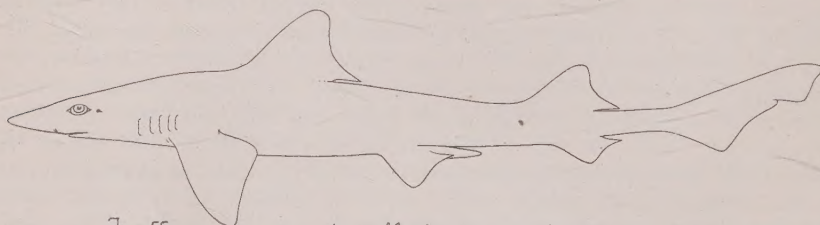


Fig 55

Henle's Shark (*Mustelus henlei*)

6. HENLE'S SHARK (*Mustelus henlei*) in general appearance is much like the last, having very fine teeth and the lower lobe of the caudal not projecting, but a magnifying glass shows that the teeth have points and that most of them in the upper jaw have a small basal point on each tooth (see fig. 55). It may be easily known from the last by the posi-

tion of the dorsal above the point of the pectoral. When the pectoral is held close to the body its point reaches to under the middle of the dorsal base. Little is known as to the range and abundance of this species as it has been passed over as the smooth hound. It is known from about San Francisco and southward.

7. THE LITTLE LEOPARD SHARK (*Triakis semifasciatus*) may be known from others of its family (see family characters above) by the definite black crossbars across the back and extending down to the middle of the side. On the lower part of the side are round black spots, one or more opposite the space between each two bars.

This shark is found south of San Francisco to San Diego. Southward it is very abundant, but not so abundant as the smooth hound. It does not exceed three or four feet in length.

8. THE SOUP-FIN SHARK (*Galeorhinus zyopterus*) (see fig. 51) may be known from others in its family (see family characters above) by the teeth on the side of the jaw being notched on the outer edge below the point and the lower part of the notch divided into from three to five points. This shark is abundant south of San Francisco, especially below Point Concepcion. It reaches a length of six feet and is of some value for the oil which its liver yields, but more particularly for its fins, from which the Chinese make a finely-flavored soup, the cartilaginous fin-rays dissolving into a nutritious gelatine. They consider the fins of no other American shark of such value for food. Most of the fins on the market are used by Chinese in the United States, but some are shipped to China.

Like most sharks, this species readily takes a hook baited with any sort of meat, but particularly with herring or other silvery fish. When hooked the big ones afford some sport, but tire easily. They are usually found in water from twenty-five to fifty feet deep, but are not uncommon in shallow water.

9. THE TIGER SHARK (*Galeocerdo tigrinus*). This shark may be known from the others of its family (see family characters above) by the presence of a pit at the base of the tail on the upper surface and in addition a pore (spiracle) just behind the eye. Two other species in this family have the pit and others have the pore, but no other has both. The teeth are alike in both jaws, large and triangular, notched on the outer margin and finely serrated (saw-toothed) on the edges. The color is brown with numerous dark spots scattered over it larger than the eye. The adults may be nearly plain. This shark is not rare in tropical seas and is reported by fishermen as occurring along the southern California coast. It is only known from this region to zoologists, however, by some jaws of a specimen captured near San Diego. It is said to reach a length of twenty-five or thirty feet, and next to the great white shark is the most dreaded by sailors, forming the basis of not a few of the forecastle "yarns."

10. THE GREAT BLUE SHARK (*Prionace glauca*). This shark differs from other members of its family (see family characters above) in having no pore behind the eye and in addition the first dorsal nearer to the ventrals than to the pectorals (see fig. 56). The color is a

light blue-gray, much lighter on lower parts. This species is abundant in tropical seas, not uncommon in British waters, and is occasionally taken about San Francisco. It reaches a length of fifteen or twenty feet and shares with many other sharks the reputation of being a man-eater.

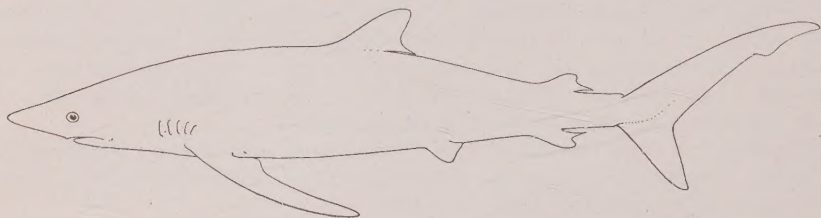


Fig 56

The Great Blue Shark (*Prionace glauca*)

11. THE BAY SHARK (*Carcharinus lamiella*). This shark and the last are the only ones of their family (see family characters above) without a pore (spiracle) behind the eye. It may be known from the great blue shark by the position of the first dorsal, which is nearer the pectorals



Fig 57

The Hammerhead Shark
(*Sphyrna zygaena*)

than to the ventrals. Color plain gray, white below. This species is known from southern California to Mazatlan, Mexico. A specimen taken at Santa Catalina Island a few years ago measured twelve feet in length.

12. THE HAMMER-HEAD SHARK (*Sphyrna zygaena*). This shark is known at once from all others on our coast by the sides of the head being developed far outwards from the rest of the body, forming outstanding lobes on which the eyes are placed (see fig. 57). The color is plain slaty-gray. This remarkable shark is common in all warm seas and occasional specimens are taken on our southern California coast. It reaches a length of fifteen feet and has an evil reputation among sailors and fishermen. Its food consists largely of bottom-feeding fishes.

13. THE THRESHER SHARK (*Alopias vulpes*). This shark may be known at once by the great length of its tail, which is about as long as the rest of the body (see fig. 58). The thresher shark is of wide dis-

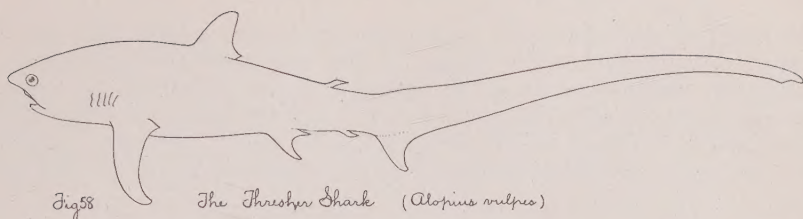


Fig 58

The Thresher Shark (*Alopius vulpinus*)

tribution, being found in all warm seas and occasionally taken on the California coast north of San Francisco. It reaches a large size and the powerful strokes it gives with its tail renders its capture a rather difficult matter.

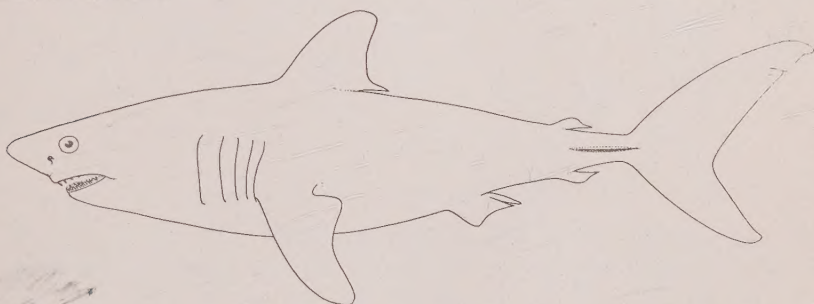


Fig 59

The Mackerel Shark (*Lamna cornubica*)

14. THE MACKEREL SHARK (*Lamna cornubica*). The caudal fin evenly rounded behind, with only a slight notch below the upper lobe; an outstanding keel along each side of the tail; the teeth sharp and their edges entire (not saw-toothed) separates this shark from other west coast forms (see fig. 59). Color bluish-black above, growing abruptly white at middle of sides. The mackerel shark is widely distributed over the northern Atlantic and Pacific and is not rare on the California coast. It reaches a length of ten feet.

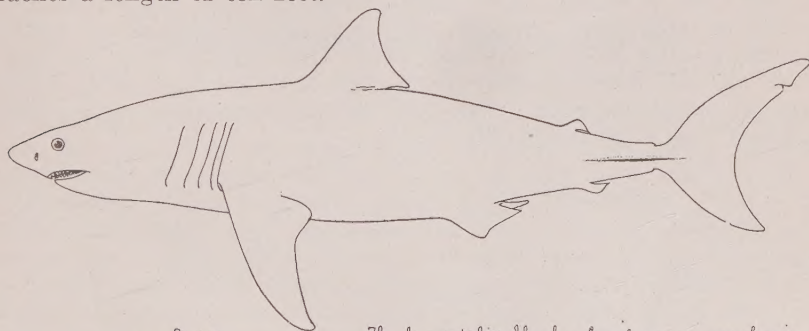


Fig 60

The Great White Shark *Carcharodon carcharias*

15. THE GREAT WHITE SHARK (*Carcharodon carcharias*). The caudal fin evenly rounded behind and with only a slight notch below the point of the upper lobe; an outstanding keel along each side of the tail, all of which are as in the mackerel shark, but this shark has the teeth triangular and the edge of each broken up into saw-tooth-like points (see fig. 60). Color, leaden gray on back and sides, white below. This

shark is widely distributed in warm seas and reaches a large size. It is probably not common in our region. A few specimens taken in Monterey Bay have been recorded up to twenty-four feet in length. A specimen recently taken at Santa Monica is said to have measured thirty-two feet in length. Among sailors the great white shark, otherwise known as the man-eater shark, has the most evil reputation of any of the sharks.

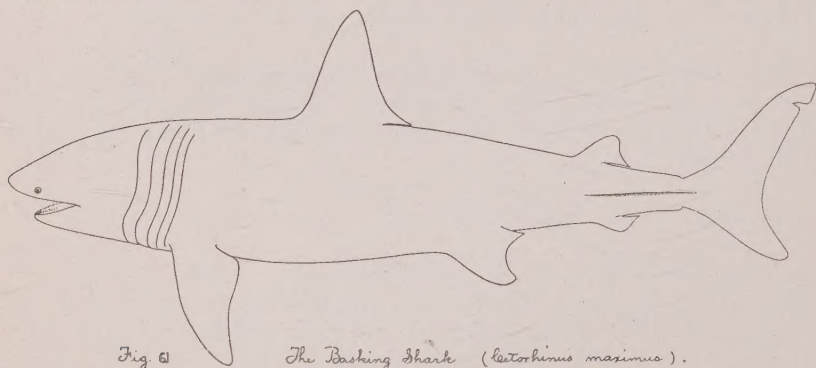


Fig 61

The Basking Shark (*Cetorhinus maximus*).

16. THE BASKING SHARK (*Cetorhinus maximus*). The size of the gill slits, which nearly meet under the throat, at once identifies this great shark (see fig. 61). It has the caudal fin and caudal keels as in the last two. The basking shark is found in Arctic seas and is not infrequently taken as far south as Monterey Bay. Recently one was taken at Santa Monica. It is known to reach a length of thirty-six feet. Its habit of remaining motionless or drifting slowly along the surface of the water as if basking in the sun has given it its common name. It is said to be easily approached and harpooned when thus at the surface, but its final capture is difficult and dangerous on account of the powerful blows it may deliver with its tail. In Monterey Bay it has sometimes been caught in gill nets by swimming into them and then turning over and over, wrapping them tightly about its head, closing its gill slits, and so strangling. Its teeth are smaller than those of any other shark, there being about 200 in each row. This, together with its long, close-set gill rakers and sluggish habits, indicates that it probably feeds upon small organisms, rather than upon fish or other animals that would entail swiftness in their capture.

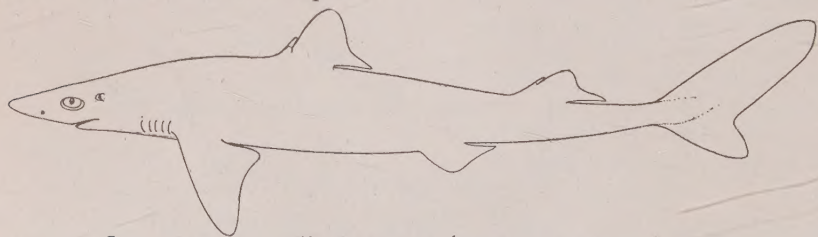


Fig 62

The Gray-fish (*Squalus sucklii*)

17. THE GRAYFISH OR DOGFISH (*Squalus sucklii*). The absence of an anal fin, together with the presence of a spine in front of each dorsal fin, at once serves to identify this shark (see fig. 62). Its color is

18. THE ANGEL SHARK OR MONK-FISH (*Squatina californica*). This shark is flat and disk-like and is more easily confused with the skates than with the sharks, but it may be known by the gill openings being slaty-gray, shading to white on lower parts. White spots are often scattered over the body, especially in the young. The grayfish is extremely abundant along our coast and northward to Alaska. South of Point Concepcion it is only found in deep water, and is probably not very common, but northward it occurs in shallow bays in great numbers. It does not exceed a length of three or four feet.

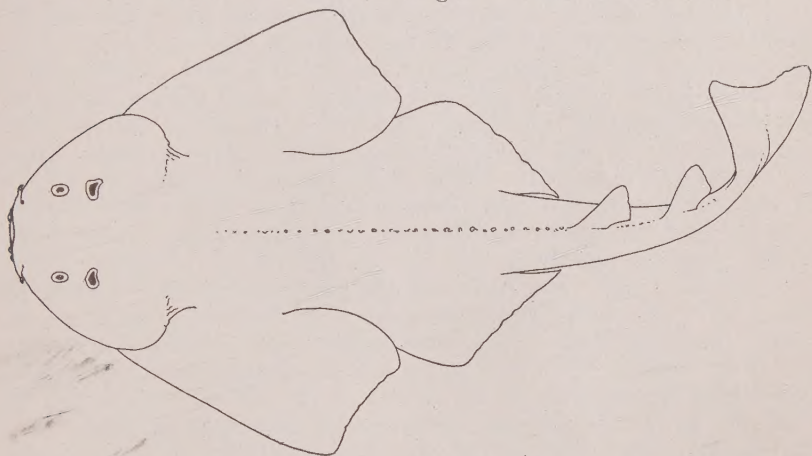


Fig. 63

The Angel Shark (*Squatina californica*)

crowded together in a deep notch behind the head (see fig. 63). It is found in all warm seas and on our coast it is not rare south of San Francisco.

TEMPERATURE AND THE ALBACORE.

By WILL F. THOMPSON.

The research on the albacore now proceeding under the direction of the California Fish and Game Commission has been under way but a short time, yet certain facts as to the correlation of the temperature with the catch seem important enough to call for remark. Rarely, in so far as the writer knows, has there been found a case in which the correlation is as evident and clearly cut. Further investigations are in progress, and it is hoped that in the final report it will be possible to indicate various interesting applications of the observations made here. The fact of the correlation can not well be doubted, but there remains the question as to whether it is not in part due to certain factors allied with temperature.

The albacore fishery, at first glimpse, is one dependent to a great degree on the activity of the fish, the acuteness of its vision, and its hunger. The boats used are large, seagoing, and motor driven, carrying three to five men. They leave port at about midnight, catching the live

bait of sardines and anchovies (or other species) with a seine before daybreak. This they place in the stern of the boat in a pyramidal box through which fresh sea water is continually pumped to keep the bait alive, for it is thought that the albacore prefers live bait to all other. Then lines with bone or rag lures, called "jigs," are dropped a hundred feet astern, more or less, and towed at full speed barely below the surface of the water until an albacore "strikes" them. Sometimes, on the best days, the fish, shining like silver in the bright sun, leap clear into the air as they strike the "jig." Then in great haste, lest the fish pass on, the live bait is thrown out in dip netfuls while the boat is stopped and brought about. The live bait attracts the school of albacore to the boat, and the throwing out of the bait is called "chumming" them. Then hooks on hand pole and lines are baited with sardines, or anchovies, and dropped overboard. The fish in the school may be seen swimming swiftly to and fro in the clear water under the boat, their long pectoral fins extended. While they remain they take the baited hooks with great rapidity; then, perhaps after a ton or but fifty pounds has been caught, the school vanishes as quickly as it came, and trolling with the "jigs" is resumed. The fish are first caught directly on the surface by the "jig," and although the fishermen speak of them as "coming up," an unprejudiced observer must hesitate long before he concludes that they abide at any considerable depth, at least during the height of the summer. Nowhere in the world is there a fishery so beautifully adapted as an index to the habits of the fish concerned, for its activity and its hunger are vital factors in the success of the catch.

Considering recent work on the effect of temperature on activity and digestion, it was entirely natural to turn to a comparison of temperature fluctuations with those of the catch, particularly as the fluctuations of the catch are such a prominent feature of the fishery. For such a comparison, the ideal data would be the temperatures of the surface water where the fish were caught, but when the variations which exist between near-by areas of water, the diurnal changes, the weekly and monthly fluctuations are considered, the number of observations necessary becomes excessive. There is a probable index to the varying temperatures of the water in the admirable records kept by the Weather Bureau of the United States, to whose various officials the writer is deeply obliged for their assistance. The minimum temperature reached during the night at such places as San Diego, Avalon, and Santa Barbara, must be greatly influenced by the warmth or coolness of the near-by bodies of water, if indeed the air and water temperatures are not resultant in good part from the same meteorological conditions. Data as to this will be presented in the final report. It has been assumed in this paper that the temperature of the air affords a good criterion of the fluctuations in that of the water.

There are of course many things about the catch which must be guarded against in accepting it as representative of the "abundance" of fish, as that term is usually understood among the fishermen. Chief among these is the fact of the derivation of the catch from different

localities at various seasons. Without going into details, it has been thought best to utilize the catch of the San Diego boats during their whole season as being derived from a region whose temperature is indicated by the San Diego records. Those of the more northern canneries in Los Angeles County take their catches almost altogether in

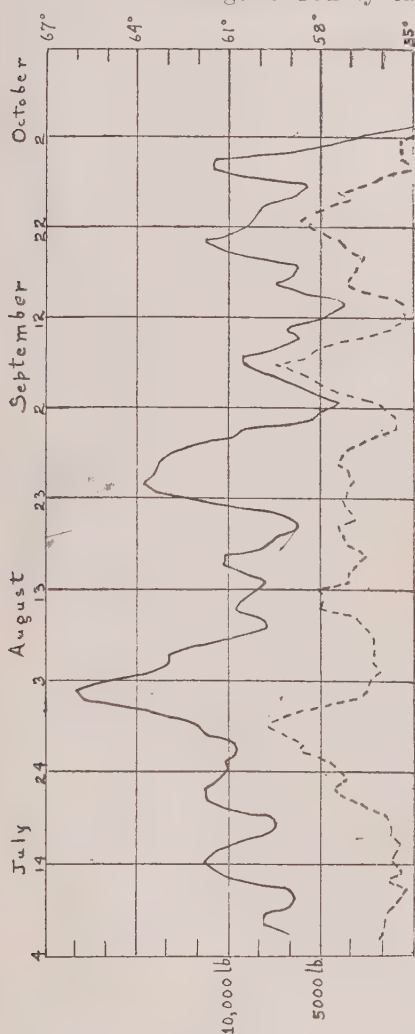


Fig. 64. Comparison of catch and temperature in the region of San Diego. Unbroken line—mean minimum temperature. Broken line—catch per boat.

the more northern districts during the latter part of the season, especially after the San Diego season has closed, and therefore emphasis is laid on that part of the record as being more apt to reflect the true condition of affairs. Important, also, is the varying ability of the fishermen, and what may be called the "catching capacity" of each boat. To eliminate this source of error, it has been necessary to treat each catch of each boat as a per cent of its capacity for taking fish as compared with other boats. The method will be detailed in the final report. The labor of such treatment was great, but the result gives an approximate idea of the fluctuation in "abundance" of the fish even when relatively few boats are considered. Other minor causes of variation could not be guarded against, and are undoubtedly the sources of certain discrepancies. In the accompanying charts the rise and fall of the catch as the season of 1916 progressed is shown by broken lines, and that of the temperature by the unbroken lines.

In figure 64 the relationship between the given curves needs no explanation, but in considering figure 65 certain things must be borne in mind. The first part of the catch is compared with the temperature curve at Avalon, as more representative of the locality in which the catch was taken, but as a matter of fact it probably came from too many regions to be strictly comparable to the temperature of any one locality. The general course of the curves is the same, however. For comparison with the latter end of the season, the temperature at Santa Barbara is taken, because of the tendency to fish in northern waters at that time, although there was not, in 1916, the usual run at Santa Cruz Island. In

order to render more lucid the agreement between the temperature and catch in September both Avalon and Santa Barbara curves are utilized for that period. The essential agreement between the minor high and low points of the three lines in that month may be easily seen in addition to the fact that both temperature and catch were steadily falling. Nevertheless, the agreement in figure 65 must be considered as being necessarily less complete than that in figure 64, because of the greater diversity in the origin of the catch.

The correlation is, however, remarkable, and can not be regarded as showing less than an intimate relationship. Most significant, perhaps, is the fact that a rise and fall in the temperature within the comparatively brief time of ten days is echoed by that of the catch. There can not be any doubt whatever that the catch fluctuates with the temperature

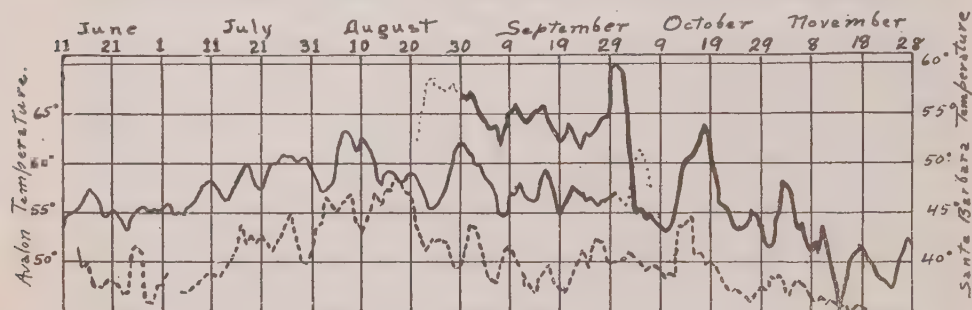


Fig. 65. Comparison of average catch of boats from Los Angeles County, with mean minimum temperatures at Avalon and Santa Barbara (city). Unbroken line to left—Avalon temperatures. Unbroken line to right—Santa Barbara temperatures. Broken line (lower)—average catch per boat.

itself, or with certain things connected with its rise and fall. The step to an explanation of the disappearance of the species during the winter is easily made, for it is hard to see wherein a brief period of low temperatures varies from winter conditions, save in duration and intensity. It would appear logical, then, to ascribe the disappearance of the fish to climatic conditions, rather than migration.

There remains, awaiting explanation, the fact that fish are caught in certain areas at times when none are caught in others. This does not mean total absence, but simply such a difference in abundance as to attract the fishermen away from one region into another. It is well known that the last of the season of fishing is spent in more northern waters, such as those around Santa Cruz and Anacapa islands. Not so well known is the corresponding fact that, in 1916 for instance, September was warmer than August near Avalon and Santa Barbara, and that the reverse was true at San Diego. The summer season came later—lagged in other words—in these more northern districts, a fact which is true of the normal temperatures as given in the United States Weather Bureau Reports for those localities. The lag was still more pronounced in 1916 at San Luis Obispo, farther north than Santa Barbara.

In observing the catch for 1917, some good examples of the varying catch in accordance with the temperature have been found. Although the total catch for the year has not as yet been compared with the temperature, it may be permissible to give portions which are approxi-

mately correct. During the first days of August, until the fourth, inclusive, the notes kept by the writer record the fact that there was a "run" of fish at Anacapa and Santa Cruz islands. This ceased about the fifth and the fishing fleet moved to the southward, catching fish nearer Santa Catalina Island, until by the eighth almost all the catch came from the vicinity of Catalina. These facts were obtained through personal interviews with the fishermen when the fish were unloaded at the canneries, and do not mean that all the fish were taken in the said localities, but that the majority of those taken by the fleet from the northern canneries were. In the accompanying plate (figure 66) the curve for the mean minimum temperature at Avalon (Santa Catalina Island) is given by means of a dotted line, that of Santa Barbara (for the vicinity of Santa Cruz and Anacapa islands) by means of a line of dashes, while the catch is represented by an unbroken line. The temperatures are those given on the daily weather charts for Santa Barbara, and will undoubtedly be subject to certain corrections, but are nearly enough correct to be truthful. The curves are smoothed by averaging in threes, an operation not affecting the variations under consideration. It will be noticed that when the catch of fish came from Santa Cruz waters the Santa Barbara mean temperature was high, but when the catch came from the southward, the same temperature fell decidedly below that recorded at Avalon. The coincidence is too plain to be illusory.

Another similar case is to be seen in the "run" of fish from Santa Cruz waters in the last of August. In considering the plotted curves given in explanation of this (figure 66), it must be borne in mind that the minimum temperature of the air does not indicate absolutely the temperature of the water, but simply probably its fluctuations. It should not be expected that the curves of Avalon and Santa Barbara temperatures be coincident, for the mean minimum temperature at Santa Barbara is normally less than that at Avalon, so that when the two do coincide, that at Santa Barbara must be considered proportionately higher than at Avalon. After August 6, and up to August 22, the receipts from Santa Cruz waters were small, forming but a small portion only of the total, but the rise in catch subsequent to that was due almost in its entirety to an influx of fish from Santa Cruz. A certain amount came from San Diego just previous to the twenty-second, but this will not enter into the consideration of the locality of the catch in northern waters. By comparing the temperature records it will be seen that the first falling off in the catch after the thirteenth resulted from or accompanied a falling temperature at Avalon, which continued low throughout the month. The increase in the catch at Santa Cruz accompanied a rise in temperature there (at Santa Barbara) and not at Avalon. In conjunction with the condition remarked on in the foregoing paragraph, it will be seen that this indicates that where the temperature at Santa Barbara (for the Santa Cruz region) approaches or exceeds that at Avalon the catch comes from Santa Cruz waters. This is not true of the earlier part of the season.

The consequences of such an obvious correlation are far reaching. Certainly the hypothesis of migration can not longer depend on the shifting origin of the catch for support, although just as truly it is still probable that a migration does occur. Until some basis for supposing it to take place is brought forward, however, it should not be utilized to explain the distribution of the species, or its absence during the winter months. There is as yet no distinction to be seen between a temporary disappearance during the summer season and that during the winter. The causes as far as we know them, which operate to

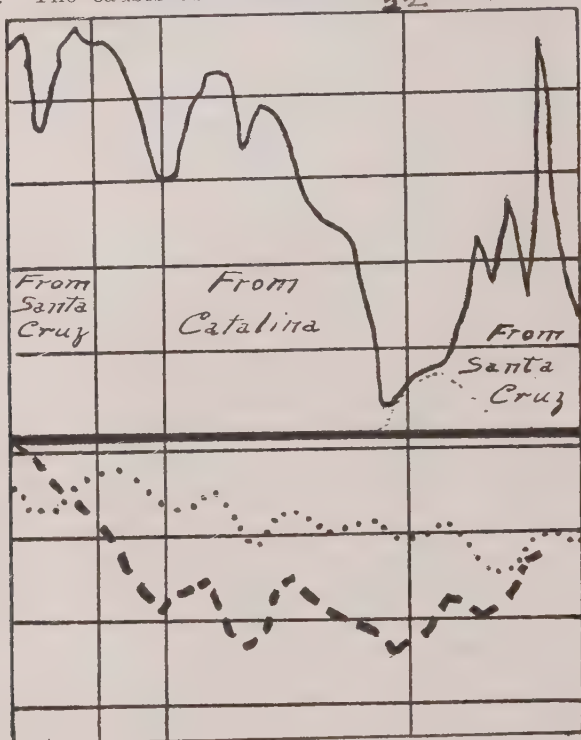


Fig. 66. Comparison of total catch of boats, with mean minimum temperatures at Santa Barbara (line of dashes) and Avalon (dotted line), showing derivation of main catch from Santa Cruz region when temperature at Santa Barbara increases relatively to that at Avalon. (Data as to catch from Canner's Clearing House.)

banish the fish from our ken, are precisely the same in both cases, except that those of winter are more extensive and correspondingly more effective.

It is possible to explain the disappearance and appearance of the albacore, by ascribing to it movements in pursuit of food. It must be shown, however, that the movements of its food (largely other fishes) are just as closely correlated with the climatic conditions as are those of the albacore. Moreover, it may be easily shown that food is not

absent from our waters during the winter months, as witness the beginning of the sardine canning season after the closure of that of the albacore. It would be unwise to in any way deny the possibility of such an indirect connection between the albacore and the climatic conditions, but there are certainly many obvious difficulties still left for solution before such can be established.

Although there is also much to be done before the direct influence of temperature on the albacore can be shown, it is possible to find many facts tending to render the existence of such very probable. The effect of temperature on the activity of cold-blooded animals has long been recognized. The lessened rate of digestion and of metabolism in the reptiles and amphibians results in the obvious and striking torpidity, the greatly lessened demand for food and for oxygen during periods of cold. The pronounced effect of lowered temperatures on digestion and physiological activities has been repeatedly shown in the laboratory. Not quite as well known, perhaps, as the effect of cold on land animals, is its effect on fishes, but gradually accumulating evidence points unmistakably in that direction. The lessened catch in line fisheries in the winter months, the fact that certain fresh water fishes lie torpid in the sand or mud during cold periods, and the now well-known and remarkable evidences of decreased rates of growth during the winter left on the scales of fishes, all indicate that the effect of temperature on cold-blooded animals is just as pronounced and universal in the water as it is on the land. If the effect is resultant from the direct influence of temperature on chemical reactions, and if an accurate and sensitive register of the activity of an animal is at hand, the variations should be as closely correlated with fluctuations in temperature as are those of a chemical reaction, or of a physiological experiment in the laboratory. As has been previously noticed, the albacore fishery is one remarkable for its dependence on the hunger and activity of the fish, and involves the presence of the albacore in the superficial strata of water—if not continuously, at least temporarily. A very slightly diminished activity would undoubtedly be mirrored in the catch.

It should not be forgotten that, because of the multiplicity of factors entering into the life of a species of fish, the probabilities are great that the catch is not an absolutely accurate and sensitive register of the direct action of the temperature, if such is present. Nor is it improbable that the catch is dependent on things which may on their part be correlated with temperature changes. Hence, although it is not to be denied that the discovery of a correlation between catch and temperature is a step toward a solution, the placing of undue emphasis on temperature fluctuations as indicative of the success or failure of the commercial fishery is earnestly deprecated.

The present paper is intended above all as an indication of what might be discovered if adequate facts and statistics were at hand. It is to be hoped that endeavors to obtain such data will meet with the earnest cooperation of those most interested, the canners and fishermen; for without such, progress will be greatly hindered.

MOUNTAIN LION HUNTING IN CALIFORNIA.

By HAROLD C. BRYANT.

It is a well-established fact that the mountain lion or cougar is the most important enemy of deer. Those who have studied the problem believe that a single mountain lion kills an average of one deer a week throughout the year, thus making a total of at least fifty victims annually. A lion often kills more than it is able to eat. There are records of one lion having killed three deer in a single night, and large deer appear to fall prey about as often as small ones. W. T. Shock followed a male lion for three days in Trinity County and found that it had killed three bucks during that time. It is evident that a lion kills many more deer in a year than many hunters do in a lifetime. This being the case, one of the dependable methods of conserving deer would naturally be the destruction of this enemy. This is exactly what is being done. The California Fish and Game Commission has offered a bounty of \$20 for the past ten years as an incentive to destroy the mountain lion, so that deer may become more abundant. During this time bounties have been paid on more than 2,500 mountain lions. The amount so expended, totaling about \$50,000, has been considered a wise investment by all those conversant with the subject because of the consequent saving of deer. The bounty on female lions was raised July 1, 1917, to \$30. Some of the cattlemen offer additional bounty as a method of reducing the destruction of stock by the lion.

Statistics appear to indicate that mountain lions are slowly becoming reduced in numbers, for in 1908 bounties were paid on 482 lions, in 1912 on 275, in 1915 on 162, and in 1916 on 179. The abundance of mountain lions in different parts of the state is indicated to some extent also by the bounties paid. Thus we find Humboldt County leading with a kill of 493 from the time the bounty was established in 1907 up to 1916; Trinity comes next with 231, Siskiyou 229, Shasta 191, Mendocino 164, and Tehama 146. All other counties show a total of less than 100 lions for the same period. Santa Barbara County has claimed a bounty on 66, which places it in the lead of other counties of southern California. It also would appear from these figures that mountain lions have been more abundant in the northern Coast Range than in the Sierras. The accompanying table (page 165) shows the bounties paid during the years 1915 and 1916.

Although a bounty has been claimed on a total of 2,526 lions up to January 1, 1917, these animals are still abundant in most of the counties named above. Nor, notwithstanding the apparent decrease in numbers, is the mountain lion yet under control, and it continues its depredations, not only on deer, but on domestic stock. D. S. Brock states, "I have known of instances of a single lion killing three large-sized hogs, averaging in weight over two hundred pounds apiece, in a single night; also of one lion killing two large deer in one night. They will occasionally kill a deer, a hog and a calf, and eat only one meal from the lot, not even returning to eat more."

How can these depredations be still further reduced? The answer is: By taking a still larger toll of lions each year. We have two means

of bringing this about. We must either interest a larger number of persons in the problem, or we must encourage those who now hunt mountain lions to greater activity by offering a larger bounty. Both



Fig. 67. A trapped mountain lion.
Photograph by O. F. Bacon.

methods will probably have to be used. The following information on the methods of capturing lions has been compiled for the information and guidance of all those desiring to cooperate in the control of this deer slayer. The facts given should interest many mountaineers and sportsmen in a practical method of increasing big game.

The destruction of a mountain lion is not an easy task and the amateur is usually quickly outwitted by the animal. Lions are usually killed by mountaineers who know well the habits of the beasts.

(This is readily proved by an examination of the claimants for the bounties.) But even though experience is a great aid, there is no reason why the amateur, if he be properly equipped, can not succeed.

A kill made by a lion is more often seen than the lion itself. Tracks and animals killed furnish the best clues to the hunter. The tracking of animals indicates that male lions cover a considerable distance when hunting. One in Trinity County when followed was found to have covered a distance of about twenty miles in three days. The same beat is often used for a long time. As a rule, the animals killed for food are only partly eaten. A male lion seldom covers his kill. The female, on the other hand, especially when hunting for her kittens, covers the kill with earth, leaves and rubbish. As a rule she hunts within a radius of five miles when her kittens are small, making a kill and then leading her kittens to it. The female is accompanied by her young for a considerable length of time; young of two sizes have often been seen with the mother. Carrion is rarely eaten, freshly killed meat being preferred.

We are indebted to several successful lion hunters for the following basic information on the usual methods pursued in hunting mountain lions in this state. This was kindly furnished in reply to a letter of inquiry.

SHOOTING.

Lions are largely nocturnal and so are seldom met with. The few which are shot by the hunter are secured by chance. Successful lion hunting is carried on by trapping or by tracking with dogs.

TRAPPING.

Mr. O. F. Bacon, Cook, California, has been successful in the use of traps. The traps, three in number, are set about eighteen inches from the bait, which is placed in such a position that the traps must be crossed in order to obtain it. Each trap is set level with the surface of the ground and covered first with a piece of cloth and then concealed

with dirt. The chain from each trap is fastened to a near-by log, capable of being dragged by the lion. The entrails of a hog or calf, either fresh or fetid, make good bait. Mr. Bacon states that he has trapped eleven lions in this way. The best success has been obtained during the winter when food is hard to obtain.



Fig. 68. A treed mountain lion in Oregon. Photograph from Salisbury Wild Life Films. (Courtesy E. A. Salisbury.)

TRACKING WITH DOGS.

The method most universally followed is that of tracking a lion by means of trained dogs. The dogs used are commonly known as "varmint" dogs. They are usually mongrels, although fox-hounds are said to be especially valuable.

The type of dog needed is thus described by Mr. D. S. Brock: "Hounds that will trail on an old, cold trail, as well as on a fresh trail, and that will trail through and by bunches of deer, paying no attention to the deer whatever, are necessary for trailing lions. Then you know there is a lion when the dog trails, whether there is a visible trail or not. You want the kind of dogs that will trail ten miles if necessary without quitting."

This method is largely used during the winter season when the tracks are easily found and followed on the snow. "I always hunt for lions in a section where deer are plentiful and then search every bluff and

every pile of rocks. In this way I am sure to cross the trail of any lion either entering or leaving its lair. As a lion is usually after prey when moving, the hunter may find a kill at any point on his trail and strike a fresh trail because the lion has returned for a meal, or he may find the lion in near-by brush or rocks." [JAY C. BRUCE.]

As soon as a fresh enough trail has been found the dogs are put on the scent and are followed by the hunter. If a fresher trail is found this is followed until the lion is treed, after which he is quickly dispatched by means of a rifle. The hunter should approach the treed lion carefully so as to avoid the danger of the lion's escape and the necessity of again treeing the animal.



Fig. 69. Mountain lion killed October 15, 1915, at Heenan Lake, Alpine County, by Martin Nomont.

A typical experience in lion hunting as given by H. C. Chester is as follows: "About ten days ago a lion track was reported to me. I took four of my dogs, three start dogs and one younger one. The trail was four days old the morning my dogs picked it up. The dogs cold-trailed it for three and one-half days. The lion advanced about fifteen miles, but back-tracked and made many circles in making that distance. Each night I called the dogs off and took a new start in the morning. The fourth day at 12 o'clock they took a hot track from where the lion had been feeding on a deer carcass, and by one o'clock they had him treed. During the seven and one-half days the lion had killed four deer that I know of, one small deer, one large doe and two very large bucks. One buck the lion killed for pleasure and left lying on the ground untouched. The other three were only partly eaten."

In presenting claims for bounty several years ago, W. R. MacArthur of Beegum, Tehama County, wrote: "These five lions represent a month's hunting and a scope of perhaps thirty-five or forty miles of the roughest country in northern California. I have some fine dogs. We

got every lion of which we found the sign with the single exception of the mother of the kittens, and I hope to get her yet. We hunted the largest of these lions, the male, fifteen days. His track was always too old for the dogs, but we finally struck it one morning fresh, and got him in an hour. In our hunt after this lion we found twelve deer that he had killed—some he had only taken one small feed out of and never returned to them. I know this to be a fact, as we went morning after morning, hoping to strike his track at the carcasses, but a male lion never comes back if he can get a fresh deer when he is hungry. Where



Fig. 70. Mountain lion kittens. From Salisbury Wild Life Films. (Courtesy E. A. Salisbury.)

they have all they want, they take one feed in twenty-four hours, and a large lion will eat a deer in two or three days. On the other hand, a female lion with kittens, of which they have from two to four, hunts for the kittens until they are over a year old, killing a deer and taking a feed out of it and allowing the kits to stay and finish it up, while she gets another. A female lion with two or three kits will eat a large deer in twenty-four hours. It is an easy matter to get the kits if one can find where they have a deer."

"While hunting lions is often strenuous work, which subjects the hunter to severe exposure in rain and snow, the chase is always interesting and exciting, and, in my opinion, much better sport than hunting either deer or bear." [JAY C. BRUCE.]

LION BOUNTIES.

Statement of lion bounties paid by the Fish and Game Commission,
1915 and 1916:

County	1915	1916	Total (Nov., 1907, to Jan., 1917)
Alameda			1
Alpine	1		1
Amador		1	9
Butte			30
Calaveras	3		11
Colusa	1		14
Del Norte	2	9	86
El Dorado		2	38
Fresno	1	1	11
Glenn			36
Humboldt	26	39	505
Imperial	1		1
Inyo	3	1	6
Kern	15	18	92
Lake	8	2	81
Lassen			6
Los Angeles	5	1	25
Madera	10	1	31
Mariposa	2	14	47
Mendocino	7	7	164
Merced			1
Modoc			3
Monterey	8	6	62
Mono		5	7
Napa			3
Nevada		2	5
Orange			4
Placer	1	4	30
Plumas			8
Riverside		3	16
San Benito	2	5	29
San Bernardino	1		14
San Diego	1	1	29
San Joaquin	2		2
San Luis Obispo	10	3	58
San Mateo			1
Santa Barbara	4	6	71
Santa Clara	1	4	12
Santa Cruz			1
Shasta	7	10	194
Sierra			6
Siskiyou	9	9	233
Sonoma		1	15
Stanislaus	1		4
Sutter			1
Tehama	4	1	147
Trinity	4	3	232
Tulare	8	8	63
Tuolumne	7	11	48
Ventura	7	1	28
Yuba			3
Totals	162	179	2,526

BOUNTY.

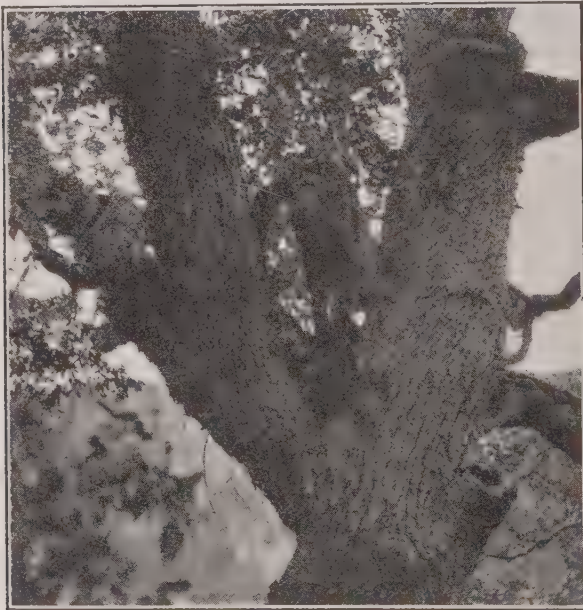
The constant demand for an increase in the bounty paid by the Fish and Game Commission so that remuneration would be sufficient to make lion hunting worth while, has led the commission to increase the bounty on female lions from \$20 to \$30 beginning July 1, 1917. All claimants for bounty must adhere to the following requirements:

The entire skin, with evidence of sex attached, of the mountain lion upon which a bounty is claimed, must be sent to the office of the Fish and Game Commission, San Francisco, all express or mail charges prepaid. Where only the scalp is sent, or in case the sex can not be positively determined, a bounty of but \$20 will be allowed. The skin should be either dried, tanned, or otherwise cured before shipment, as green skins spoil quickly, becoming very offensive and losing all value. Offensive green scalps or skins, or those sent charges collect, will not be accepted.

All hides and scalps received by the Fish and Game Commission will be destroyed unless full directions are given for return to claimant, or for other disposition. A tag with name of claimant, together with shipping directions thereon, should be attached to hide or scalp. All return shipping charges must be paid by claimant or other person receiving package.

A claim must be made for each animal, upon a form provided by the Fish and Game Commission, whereupon must appear the names and addresses of the claimant and three witnesses. This claim must be acknowledged before a notary public or justice of the peace, and must bear the county clerk's certification to the genuineness of the justice's signature. If sworn to before a notary public this will not be required. Affidavits of witnesses are not required.

The claim must be accompanied by an account of the pursuit and killing of the lion, giving in detail the method used, number of deer carcasses left by the animal, and such other facts as may be of assistance to the commission in determining the damage done to deer and other game. Claim blanks will be sent upon receipt of written application to the Fish and Game Commission.



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All material for publication should be sent to H. C. Bryant, Museum of Vertebrate Zoology, Berkeley, Cal.

October 27, 1917.

The study of birds has a remarkable educational value and should be advocated not for the sake of the birds alone, but for the good of the children. It gives to many of them a new outlook, a new interest in life, and develops their observational faculties in the natural way.—*E. H. Forbush.*

HIGH COST OF FISH.

There are three good reasons why Californians have to pay high prices for fish:

1. People in California do not subsist to any great extent on fish as do the people of many foreign countries.
2. Californians seldom eat fish in summertime when large catches are made and when prices are low; on the contrary, demand is increased in winter when large catches are least often made.
3. Many people eat fish on one day a week only. As a consequence, fish dealers have to charge enough on these days to make up for those not sold on other days of the week.

VALUABLE INFORMATION FOR ALBACORE INDUSTRY.

The investigations on the albacore industry instituted by the Fish and Game Commission are bearing fruit. In this number of CALIFORNIA FISH AND GAME (page 153) Mr. Will F. Thompson points out that there is a correlation between the catch of albacore and the temperature. It is needless to state that if this point can be substantiated albacore fishermen will have the information they have desired for so long. The ability to predict the catch and dependable information on the location of the albacore at all times of the year seems an immediate possibility.

BAY REGION FISHERMEN LUCKY.

The far-sighted policy of the Fish and Game Commission in introducing new food and game fishes into the waters of the state is evidencing itself in a new way. Because bluegill sunfish and calico bass were planted in the Sacramento and San Joaquin rivers about ten years ago, the delta region has become a fisherman's paradise. The bluegill sunfish and calico bass now swarm in the sloughs and fishing is reported as excellent in Whiskey, Potato, and many other sloughs. These fish readily rise to a fly. They are game, too, and the same sort of sport which is sought by the fly fisherman can now be obtained within fifty miles of San Francisco. Many believe the bluegill and the calico bass to be better flavored and more palatable than trout. The finest of fishing grounds are therefore accessible to everyone in the bay region. All who will arm themselves with an angler's license, a rod, midget flies, and who choose some "blind" slough at low water, can bring home the limit, and at the same time enjoy sport superior in some respects to that found on the mountain streams.

MILLIONS OF POUNDS OF SARDINES CANNED.

Unheard of catches of sardines have been made along the coast of southern California this past spring. The canneries which heretofore have been idle except during the run of tuna have been busy putting up tons of sardines. Up to the middle of June 60,000,000 pounds of sardines have been canned, this being three times the amount canned during 1916. It is expected that the amount already canned will be doubled by the end of the year. Until recent years the salmon fishery was the largest in the state; later, the sardine fishery forged ahead. In 1916 the tuna fishery of southern California loomed up as the principal fishing industry, 30,000,000 pounds being canned. In 1917 the sardine industry undoubtedly will hold first place.

California sardines are just as good as the imported ones. In fact, one gets more for the money because of the fact that our sardines are of larger size. Most of the California sardines are put up in pound cans retailing at 20 cents, but they can also be obtained in the usual flat cans.

Our nation is wisely turning in the food crisis to the resources of the sea. "Old ocean" has a full larder and we can easily draw upon that larder to feed ourselves and our allies as well.

WHALE MEAT—VENISON OF THE SEA.

A whale is now valuable not only for its fat, but for its flesh as well. Each California gray whale will produce about ten to twelve tons of fresh meat. Formerly this meat was unutilized; now it finds its way to the markets. During December, January and February, 1917, eight whales were captured off the coast of southern California. Some of the meat from these whales retailed at fifteen cents a pound. Some of it was canned. Although in early days used in part by the whalers for food, in more recent years nothing but the oil has been taken from the whales killed. The meat is more tender than beef, is very palatable and exceedingly nutritious. It should be remembered that a whale is not a fish, but a mammal. Hence it is no wonder that whale meat tastes like tenderloin. The cannery of southern California have been anxious to put whale meat on the market under a trade name, because the unin-

tiated appear to be afraid to try this new food, but the government will not allow it to be mislabeled.

Modern whaling is carried on with a sixty-foot boat, with powerful engines, and the instrument which does the killing is a Norwegian harpoon gun. After a whale is towed into port the whole carcass is utilized even to the bone and skin. The bone can be used in the manufacture of buttons and there is evidence that the skin can be converted into leather. The blubber from an average-sized whale will make about 160 barrels of oil valued at thirty dollars per barrel.

Doubtless we have been missing one of the choicest products of the sea and before long we will find that whale meat is one of the greatest delicacies, selling at fabulous prices. Now is the time to pass your judgment on the "venison of the sea."

JUSTICE METED OUT.

In view of the miscarriage of justice so often seen when murderers of game wardens escape penalty, we are very glad to report that Nino Lombardo has been sentenced to life imprisonment and the other murderer of Deputy Ray Heacock, Dimmaggio by name, to ten years in San



Fig. 72. Advertising whale meat in Long Beach, California. The whale should furnish cheap and nutritious meat during the present war emergency.

Quentin. The appeal originally made was dismissed and these men are now serving their sentences. A third man implicated in the murder will be tried in October. It will be remembered that Deputies Ray Heacock and Richard Squire were murdered by Italian fishermen while doing patrol duty near Terminus, San Joaquin County, last December.

BROUGHT TO JUSTICE.

John W. Guelph of Sierra Madre recently was fined \$50 by Judge McDonald of Pasadena for killing a deer out of season and for killing a spike buck. Neither Mr. Guelph's claim of relationship to the royal family of England nor his contention that the deer were destroying his property saved him from the fine.

IN MEMORIAM.

LEO N. PETTIT.

Mrs. Leo N. Pettit, an employee of the Fish and Game Commission for sixteen years, died at the Roosevelt Hospital, Berkeley, in the early morning hours September 11, 1917.

Mrs. Pettit was one of the most valu-

able and conscientious employees of the Fish and Game Commission. She entered the service as a stenographer and on account of her earnest application to her work and her peculiar fitness, she was advanced and at the time of her death held the very important position of chief clerk.

All with whom she came in contact were impressed with her thoroughness and ability. A capable business woman and a true friend, she is mourned by her associates and friends innumerable.

Mrs. Pettit is survived by a son, Jack, her mother, Mrs. N. L. Nielson, and a brother and sister.—J. S. H.

THE PASSING OF A PIONEER.

Samuel Nickel, watchman, spawn-taker, fisherman, employed for years by the California Fish and Game Commission, was stricken with paralysis in his cabin on Camp Creek, Siskiyou County, on August 26, 1917. He was removed to a hospital in Yreka, where he passed to eternal rest on the twenty-eighth day of August, 1917. Mr. Nickel was born in Ohio in 1833; came across the plains to California in 1849; engaged in mining in California and Nevada for a number of years. He



Fig. 71. Samuel Nichol, for many years a faithful employee of the Fish and Game Commission in the capacity of watchman and spawn-taker.

moved to Lake Tahoe thirty-five years ago, where he engaged in lumbering, fishing, trapping and pursuits generally followed by mountaineers. He was first employed by the Fish and Game Commission in 1890 as a fisherman for spawn fish at the egg collecting station on Lake Tahoe. He assisted in this work for a number of years. Three years ago he was transferred to the Klamath stations of the Fish and Game Commission, where he was engaged as watchman and spawn-taker up to the time of his death.

Sam Nickel was a lover of nature, a true sportsman, a faithful and loyal friend. The employees of the Fish and Game Commission who were associated with him in his work will long remember his kindly nature and genial disposition. He lives in our memory and in the memory of those who loved him. He leaves a sister and two nieces to mourn his death.

THE CLEAN RECORD.

"There is nothing in all the world sweeter than the memories of an old sportsman whose record is clean, nothing more poignant than those of one whose is not. Let every word and deed said and done in the name of sport be such that as memories they will bring not the least regret. Be patient, be kind, be generous, be fair, that when your hair is white your heart may be warmed by dreams of days in Been-There Land."—*The Conservationist*, March, 1917.

OREGON LIBERATES MANY GAME BIRDS.

The Oregon Fish and Game Commission has enlisted the aid of farmers, ranchmen, and country estate owners in restocking the state with game. Game birds are being reared by private individuals in every county of the state.

The census of game birds liberated in 1916 is as follows: Chinese or ring-necked pheasants, 2,914; bob white quails, 973; California valley quails, 959; mountain quails, 142. As a result of this plan, stimulation of private breeders netted a total of 4,988 game birds.

Not only does such cooperation mean an increase, but it binds more closely into a common cause the public and the State Fish and Game Commission.

BIRD PROTECTION SIGNS DISTRIBUTED.

Those wishing to prevent shooting on their premises will be interested in cloth signs issued free of charge by the National Association of Audubon Societies, which read as follows:

SHOOTING ON THIS PROPERTY IS PROHIBITED. WAR.

PROTECT THE BIRDS AS A WAR MEASURE!

The food destroyed in America by insects and small rodents would feed the people of Belgium! Birds are the great natural enemies of these pests. The laws of the state and of the nation protect insect-eating birds, but many are being shot wantonly and for food. Report violations to the nearest game warden or to the address given below.

NATIONAL ASSOCIATION OF
AUDUBON SOCIETIES
1974 BROADWAY NEW YORK CITY

AGE OF DEER DETERMINED BY TEETH.

In the 1916 Biennial Report of the State Fish and Game Commissioner of Vermont attention is called to a method of determining the age of Virginia deer by their teeth. The Vermont law provides that it is unlawful to kill "an animal of the first year." It is therefore necessary to distinguish fawns from yearlings. A collection of jaws, obtained by a taxidermist, indicates that the length of the jaw and the character of the teeth is a more dependable means of determining age than the number of points on the antlers. The following interesting table gives measurements of nine jaws:

Number	Length of jaw	Number of points	Width of antlers
1.....	6½ in.	Fawn	Fawn
2.....	8 in.	2 splke horn	8 in.
3.....	8½ in.	4	11 in.
4.....	8½ in.	6	14 in.
5.....	8½ in.	6	17 in.
6.....	8¾ in.	8 heavy	20 in.
7.....	9½ in.	10 heavy	19 in.
8.....	9¾ in.	10	22 in.
9.....	10 in.	8 uneven	23 in.

Although of possible value as a means of ascertaining the age of a deer already killed, we fail to see how this method can

be employed in judging the age of deer in the wild, a necessity under the present Vermont law.

AN OBJECT LESSON.

Vermont has again demonstrated what conservation can do for deer. The last report of the Fish and Game Commissioner states that 6,042 deer (bucks and does) were killed during the open season of 1915. When it is known that the area of Vermont is less than one-seventeenth that of California, we are led to ask the question: "Why is our estimated kill of 12,000 buck deer per year not larger?" The total absence of mountain lions in Vermont may in a measure account for the discrepancy. The toll taken by mountain lions in California if added to our kill of deer would materially increase the total.

AMBERGRIS.

The finding by a fisherman upon San Francisco Bay of a mass of material that had the appearance of ambergris led to an investigation whether or not this substance was found along our coast. Upon applying the old test of the insertion of a hot needle to draw forth a peculiar musky scent and to show a fatty consistency, the fisherman's discovery did not prove to be ambergris, and as far as we have been able to find out, this valuable substance has never been procured in quantity on the California coast.

To those not familiar with the word we offer the following facts gleaned from Scammon's "The Marine Mammals of the Northwestern Coast of North America."

Ambergris has for many years been the basis for a great number of perfumes. Although quantities have been obtained sufficient for such use, yet the source of the substance was a mystery for many years. Great masses of a yellowish, transparent substance was found in considerable quantities floating in the Indian Ocean or along its shores; lesser quantities have been found in other parts of the world.

The demand for this commodity is indicated by the high price paid in 1791, \$6 per ounce. As early as the sixteenth century it was valued by the English. At that time a queer myth of its source existed in the tradition that ambergris issued

from the root of a tree, which shot its roots towards the sea, and later by the washing of the warm waters the gum was cast upon the shore. Somewhat later in the century we find the term "amber-griese" associated with the whale, for one Dr. Thomas Brown attests that great lumps were found by the leviathan and swallowed.

In these same days country doctors resorted to powdered whale's tooth as a cure for smallpox and other diseases. The medicinal properties of ambergris were recognized also, and doses of unadulterated ambergris were prescribed in quantities of thirty grains; indeed, a sailor is said to have tried its efficacy by taking half an ounce.

Ambergris is now known to be the excreta of the sperm whale, a fact well proved by its being composed very largely of the remains of squid.

SCIENCE IN THE INCREASE OF BIRD LIFE.

Thoughtless destruction of birds and a decrease in numbers owing to altered conditions, has brought about an interest in methods of attracting birds. Oftentimes the man who is planning a country home is desirous of knowing how birds may be attracted to his place. The United States Department of Agriculture has been helpful in furnishing several bulletins dealing with food plants. Methods of furnishing an increased food supply during the winter season have also been developed in this country.

However, it has been left to a man in Seebach, in Thuringia, to work out practical measures for increasing bird life in a limited area. This man, Baron von Berlepsch, working on the theory that the most important step for bringing about the successful protection of birds consists in establishing suitable conditions of life and, above all, opportunities for building nests, has evolved a certain scientific practice. The results obtained clearly demonstrate the practical value of the methods used.

Chief among these methods are the planting of shelter woods and hedges and the proper pruning of these to furnish nesting places. In addition, such common sense measures as the leaving of fallen leaves to provide increased food

for birds by furnishing food and hiding places for insects, the placing of brush and woodpiles and the delay of pruning until after the nesting season, are utilized.

Any one desiring to introduce special measures for the protection of birds should see one or all of the following:

"How to attract and protect wild birds." Martin Hiesemann. 100 pp. Witherby & Co., London, 1912.

"Attracting birds." Gilbert H. Trafton. 172 pp. National Association of Audubon Societies, 1974 Broadway, New York City.

Bulletin No. 1, National Association of Audubon Societies, "Attracting birds about the home."

A LETTER TO A GAME WARDEN.

Frequently the Fish and Game Commission and its deputies receive amusing letters. A complaint recently received by Deputy Harris, Yreka, California, reads as follows:

"G. W. Harris, the so culled "white-Injins," are killing a way over their limit

Pretty soon no more Deer aller same Ilen's teeth.

Black Klamath injin."

CIVIL WAR VETERANS OBTAIN LICENSES FREE.

At the last legislature both the hunting and angling license acts were amended to the effect that licenses be issued to Civil War veterans at no cost to them. In order to keep the records clear, however, it has been found necessary to issue such free licenses only at the district offices of the Fish and Game Commission at San Francisco, Sacramento and Los Angeles. No licenses will be issued to Civil War veterans at the offices of county clerks or at other places where licenses are ordinarily sold.

THE BOY WITH A GUN.

Whenever I am asked by some bird lover how boys can be prevented from shooting birds with air guns, I reply: "A boy with a gun is like a cat—everything is prey that wears feathers. Here is the only effective remedy: Teach bird study in the schools as a part of the conservation of national resources. Get children organized into bird clubs. A boy is not likely to kill birds if he knows one

from another, is interested in their lives, and has done something for the birds and received pleasure from them. The state protects all birds except eight, and you can report violations of the law to the game warden, or to the president of the Audubon Society. But the latter course will avail little, as long as people are ignorant of birds.

"The present game laws are not better enforced because they are not supported by public opinion and because one game warden can not adequately patrol a territory half as large as Massachusetts. If every bird were protected and a property owner allowed to kill only those birds that he found actually doing damage, then every boy or hunter with a gun would not have a practical license to kill every bird he sees, as he does under the present law. Three hawks and one owl are now unprotected, and as a consequence every hawk and every owl are killed for sport. The other day a man in Mission Valley, San Diego County, was killing the harmless fly-eating black phoebes because he "thought they were butcherbirds." Can you tell me what damage butcherbirds could do that man?" They gorge themselves on Jerusalem crickets, which are enemies of every root crop. Change the present law. Make every policeman, constable, and forest ranger a game warden. Have a couple of mounted policemen to ride over the county as they do in Canada. Teach bird study in the schools. Then you will get somewhere with bird protection."—C. D. Scott.

REMEMBER THE BUFFALO.

Commercialization of wild life leads to extermination. Evidence of the extent to which the buffalo was commercialized in former times is to be found in the following poster issued by the Burlington and Missouri-River Railroad Company and distributed in England in 1871. We are indebted to Mr. Kenneth Watson, a prominent insurance man of San Francisco, for the privilege of seeing the original. The poster is a most interesting side-light on the causes of extermination of one of America's largest and finest game mammals.

GRAND BUFFALO HUNT.

A Grand Buffalo Hunt will be held in September next, on the prairies of NEBRASKA and COLORADO, United States, and through the magnificent valley of the Republican River, the rich alluvial feeding grounds of the Buffalo.

The valley of the Republican River possesses some of the most varied and magnificent scenery in America, the wild pastures are rich in grasses, and it is most beautifully wooded and watered by clear streams and rivulets. The southern portion of Nebraska, through which the Republican Valley passes, will bear comparison either for climate, soil, or picturesque scenery, with any country.

The Burlington and Missouri-River Railroad Company own some millions of acres of land; is one of the most wealthy and influential Corporations in the Western States of America, and will aid and assist this Hunting Party in every way, in order that the Sportsmen of England may see the Western Country; and, on their return, be able to corroborate the statements as to climate, accommodation provided by them, and the gigantic advancement made in cultivation and general improvements in so new a country, for at least 200 miles from the Missouri-River.

Mr. CHARLES S. DAWSON, of the Burlington and Missouri-River Railroad Company, who left England last April, has made arrangements in Nebraska with Mr. Ward Manley, and a corps of Western Hunters, Trappers, and Scouts, of the Western Frontier of the United States, for a Grand Hunt on the plains of Nebraska and Colorado, and in the valley of the Republican River, where Buffalo, Elk, Antelope, Red Deer, Beaver, Otter, Wild Turkey, Prairie Chicken, &c., abound in large numbers; the Buffalo in herds of from 3,000 to 10,000. THERE ARE NO HOSTILE INDIANS IN NEBRASKA WHATEVER; friendly chiefs of the Otoes, Pawnees, &c., will accompany the party.

The Commissariat will be in charge of Mr. J. N. Townley, of the Tichenor House, Lincoln, Nebraska, at which place the passengers will rest a day after the journey, make preparations for the Hunt, and leave their heavy baggage. Mr. Townley will be accompanied by an efficient corps of cooks, men to pitch and strike camp, and attend to baggage. Sportsmen will be provided with army tents and beds during the Hunt, and everything generally found in a first-class Hotel. There will be servants to take care of the horses, and in fact all arrangements have been made to give the Hunting party the greatest amount of pleasure with the least possible trouble.

The party will be accompanied from Liverpool, by Mr. Dawson. His assistants will take charge of the baggage through to Lincoln, Nebraska.

The magnificent Steamer, *Atlantic*, of the White Star Line, leaving Liverpool, 12th September, has been selected to convey the Hunting Party to New York, whence they will be taken by Express Train of Pullman Palace Drawing Room and Sleeping Cars, via Pennsylvania Central R. R., across the Alleghany Mountains and Indiana to Chicago—where time will be allowed to view the burnt City—then across the highly cultivated Prairies of Illinois to Burlington, Iowa, at which point the Mississippi River is crossed, where the cars of the Burlington and Missouri-River Railroad Company, to which a Dining Room Car will be attached, will convey the party over the mighty Missouri, and the State of Iowa, to Lincoln, Nebraska.

Parties may, if they wish, return by way of "Niagara Falls," and thus see one of the grandest sights in the world.

Wagons will be provided for the conveyance of any trophies of the chase, such as Buffalo Skins, Elk Horns and Antlers in limited quantity.

The man of science looks to America as the best field wherein to investigate the changes which have affected this earth. In Europe, and more particularly in Great Britain, this is difficult to do. It is where nature is still free that he seeks to discover the great facts of natural progress. The antiquarian can find there ample opportunities for pursuing objects of interest to him, for there is no land so rich in traditionary lore, and abounding in so many relics of a bye-gone age and race, as that of the United States of America. The sportsman has there a field of nature's own planting on which to roam in pursuit of his healthy and invigorating pleasures; and where can the lover of scenery find greater, grander, lovelier views than are to be found on the Continent of America?

FARE—For the Round Trip of about Seven Weeks including every expense, except Wines, Liquors, Cigars, Guns, Rifles, and Ammunition, 90 Guineas.

The arrangements will be such as to admit of Ladies joining the party, but the charge for Ladies will be 100 Guineas each.

For further particulars apply to

The Burlington and Missouri-River Railroad Company,
16, SOUTH CASTLE STREET, LIVERPOOL;
25, MOORGATE STREET, LONDON;
59, ROBERTSON STREET, GLASGOW.

C. R. SCHALLER,

EUROPEAN COMMISSIONER FOR THE BURLINGTON AND MISSOURI RIVER RAILROAD COMPANY.

CANNING SEA MUSSELS.*

The sea mussel is of all the shellfish particularly adapted for canning. Unlike the oyster, it remains tender and retains its full flavor when subjected to the high temperatures necessary to prepare it in this way. The process which has been devised as most feasible is as follows:

The mussels when taken from the collecting boats are rapidly picked over by hand to eliminate any dead or unhealthy ones which may be present, as well as the coarse adhering debris. Then they are placed in a cleaning apparatus. * * * It consists of a rectangular box 2 x 2 x 3 feet, which revolves on its long axis. The ends of the box are of solid yellow pine and are firmly held in place by four pairs of braces 3 feet long, 2 inches wide, and $\frac{1}{2}$ inch thick. Three sides of the box are inclosed with $\frac{3}{4}$ -inch mesh galvanized wire netting. The fourth side has a door 8 inches wide, running the length of the box. The door is clamped firmly in place by means of a lever, which is swung over it. The rest of the side is filled in with parallel strips of wood placed $\frac{1}{2}$ inch apart. The projecting ends of the axis rest on the walls of a trough 1 $\frac{1}{2}$ feet deep, in which there is running sea water. A crank at one end serves as a means to rotate the cage.

About one bushel of mussels is placed in this cleaning apparatus, which is set in rotation at the rate of thirty revolutions a minute for fifteen minutes. The treatment cleans off from the shells all clinging seaweeds, sand and debris, besides breaking open the shells of dead mussels and washing away the injurious substance contained within them. In the experimental work this method of cleaning mussels proved very effective. For cleaning on a commercial scale the device may easily be constructed on larger dimensions and operated by means of steam or water power.

After this treatment the mussels are removed and rinsed off with clean water. They are placed in a chest and subjected to live steam for from five to ten minutes, or until the shells begin to open. They are next emptied out into shallow pans to cool and the natural liquor which has

escaped into the chest is preserved in a separate dish. As soon as they are cool enough to be handled, the mussels are shucked and the horny "beard" removed, the meats and liquor being preserved in separate dishes.

While the liquor taken from the steam chest and that taken from the mussels during the process of shucking is filtering through a fine-meshed cloth, the mussel meats are packed in glass jars or bottles. The filtered liquor is brought to a boil and two ounces of salt are added for each gallon. The jars containing the meats are then filled with the boiling liquid and sealed. To insure complete sterilization, the sealed jars are placed in a steam chest and subjected to five pounds pressure for fifteen minutes. They are allowed to cool down slowly and when the temperature has fallen to about 100 degrees F. they are removed and set aside for future use.

Persons wishing to can mussels for use in their own homes and who lack the facilities described in this process, may do so by modifying the method in the following way: After thoroughly cleaning the outsides of the mussels by means of a stiff-bristled brush, rinse them in clean water and place them in a large, closely-covered kettle with a little water covering the bottom—about one cup of water to each gallon of mussels. Place on the stove and bring to a boil, continuing the cooking for about fifteen minutes, or until the top shells have opened. Pour out the liquor that has collected in the bottom of the kettle and preserve it in a separate dish from the mussels. Shuck the mussels, being careful to remove the byssus or horny tuft of threads growing out from the base of the foot. While the liquor is filtering through a fine-meshed cloth pack the meats in pint or half-pint glass jars of the ordinary household type. To each quart of the filtered liquor add one heaping teaspoonful of salt and bring it to a boil. Pour the boiling liquid over the mussel meats, filling the jars to the brim, and then quickly clamp or screw on the lids. The jars should next be placed in a large vessel, such as a washboiler, containing boiling water, and left to boil for at least half an hour. At the end of this time the vessel with its contents should be removed to the back of the stove and allowed to cool. As soon

*The Food Value of Sea Mussels, by Irving A. Field, in the Bulletin of the Bureau of Fisheries, Vol. XXIX, 1909, pp. 111-113.

as convenient the jars may be removed and the tops tested to see that they are sealed air-tight. Treated in this manner, the mussels ought to keep for many months and preserve their natural flavor. When desired for use on the table they may be prepared according to almost any of the methods employed in preparing the fresh mussels for food.

SWORDFISH AND TUNA FISHING EXCELLENT.

The famous game fishes of southern California—the tuna and broadbill swordfish—have been furnishing excellent sport this season. At Catalina Island during June but one tuna was hooked. During July fourteen were caught, and in August 291. During the same period eight broadbill swordfish were landed on regulation tackle, and several marlin swordfish took hooks, but succeeded in getting the better of the anglers.

PETS, THEIR HISTORY AND CARE.

Every person interested in keeping pets has doubtless noted the lack of printed information on their care. At last there has been published an excellent book which contains just the information desired by the average person interested in pets. The author of the book, which is entitled "Pets, Their History and Care," is Mr. Lee S. Crandall, assistant curator of birds, New York Zoological Park, a man who has had wide experience in the care of birds and animals in captivity.*

The introductory paragraph of the preface aptly points out the value of fostering the interest of children in keeping pet animals. Mr. Crandall says:

"Every normal child, of whatever race or creed, is born with an innate love for wild things. If allowed to languish from lack of intelligent parental interest and supervision, this natural instinct is gradually lost or degenerates into the unintentional cruelty of ignorance. Properly fostered and developed, it is certain to exert a beneficent influence on the trend of developing character. Given scope and sympathetic guidance, the young mind is trained to observe and appreciate the subtle ways of nature, an accomplishment

which, in later years, will prove, if nothing more, a welcome diversion. The sterling qualities of kindness, responsibility and regularity are required, and many of the problems which perplex the adolescent adjust themselves normally by constant contact with reproductive life."

With the exception of a few such animals as the lamb, calf and colt, whose care is well understood, practically all those birds and mammals which make successful pets are given treatment. Although certain birds, such as pheasants, cranes and waterfowl, can not be considered as pets in the sense that they may be fondled, yet because of the fact that they are kept for ornaments and their proper treatment is not well known, they are included. The reader is asked to rely upon works of natural history for detailed description and for wild habits, in that captivity is the keynote of the book.

In each chapter emphasis is placed on general care of the different groups of animals and birds and special treatment, including feeding, is given under the head of each species. Under mammals, chapters are devoted to dogs, cats, rabbits, guinea pigs, rats and mice, and small wild animals. Under the section devoted to birds can be found information on pheasants, peafowl, quail, pigeons, doves, cranes, waterfowl, hawks and owls, parrots, cage birds, canaries and bantams. Another section is devoted to reptiles and batrachians, and a fourth to the aquarium.

Although recommending that any creature seriously ill should be treated only by a trained person, yet a valuable chapter is devoted to birds' diseases. It is interesting to note that the medicines used are, without exception, the same as those used for like ailments in man.

The appendix contains a brief but interesting statement of the "Theories of Breeding," attention being called to Mendel's law, to selection, and to inbreeding. A valuable list of practical reference works concludes the volume.

Of particular interest to the casual reader are some of the facts regarding the history of some of our commoner pets. Here we find mention of the wild ancestors of the dog, cat, guinea pig, and other animals and birds. To the child or the grown-up who wishes answers to such questions as "Where did our dogs come

*Pets, Their History and Care, by Lee S. Crandall; Henry Holt & Co., New York, 1917; 372 pp. illus.

from?" "What does a monkey eat?" "What type of cage is best for young birds?" "How are young ducks reared?" "What species of parrot is the best talker?" "What other birds besides parrots learn to talk?" and "What sort of canary is the best singer?" now have their questions answered in "Pets, Their History and Care."—H. C. B.

CALIFORNIA CONDOR ON EXHIBITION IN GOLDEN GATE PARK, SAN FRANCISCO.

Although the condor is the largest land bird that flies in California, and was once so plentiful that everyone was acquainted with the bird, yet at present it is limited to a few districts, and there are but few individuals who see the bird.

During June, 1917, a vaquero named Rocky Digges discovered one of these huge birds feeding on the flesh of a dead horse in Monterey County. He waited until the bird had become fully gorged with food before attempting to lasso it. Before the condor could take its needed run to rise in the air, his lariat fell around its neck, and the bird was taken captive.

As an earnest attempt is being made to carefully protect this bird, it was confiscated by the Fish and Game Commis-

sion and turned over to the California Academy of Sciences. The academy in turn had it placed in the aviary at Golden Gate Park, San Francisco, where thousands may view the fine living example of California's largest bird.

FUNCTION OF THE GAME AND FISH DEPARTMENT.

The function of the Game and Fish Department is to coordinate and employ all agencies that tend to arrest the destruction of wild life and to encourage every attempt at building up this resource. It should not be merely a police department, but an administrative branch of the state government engaged actively in constructive work in cooperation with all other organizations and agencies.—*Fins, Feathers and Fur*, December, 1916.

USUAL REPORTS NECESSARILY OMITTED.

The death of Mrs. L. N. Pettit, chief clerk in the San Francisco office, an efficient and loyal employee of the Fish and Game Commission, has made it impossible to publish the usual financial reports. They will appear in the next number.

HATCHERY NOTES.

W. H. SHEBLEY, Editor.

TROUT FRY DISTRIBUTION, 1917.

During the month of May the distribution of trout fry from the different hatcheries was commenced. This work has been completed at most of the smaller stations, and the hatcheries closed for the season. At the larger hatcheries, however, distribution operations will not be completed until the middle or latter part of October.

SNOW MOUNTAIN STATION.

After completing the egg collection operations at the Snow Mountain Station, during the latter part of May, it was found that in excess of 6,000,000 steelhead trout eggs had been taken. The eggs were "eyed" and shipped to Mount Shasta, Mount Whitney, Fort Seward and Ukiah hatcheries, to be hatched, reared and distributed in the streams suitable for this variety of trout. Two hundred thousand of the eggs were retained at Snow Mountain Station, where they were hatched and distributed in several of the tributaries of South Eel River, above the Snow Mountain dam.

UKIAH HATCHERY.

A half million steelhead trout eggs were shipped from Snow Mountain Station to Ukiah Hatchery, and during the months of June and July were given a wide distribution in the waters of Mendocino and Sonoma counties.

FORT SEWARD HATCHERY.

Steelhead trout eggs to the number of 1,350,000 were shipped to Fort Seward Hatchery from the Snow Mountain Station, and in addition to this number, 150,000 rainbow eggs were received from the Domingo Springs Station in Plumas County. The work of distributing the resulting fry was commenced during the fore part of July. Most of the fry have now been distributed, the many streams of Humboldt County receiving most of the fish. A couple of shipments are yet to be made to streams in Del Norte County, but this work will probably be completed by the middle of September.

BROOKDALE HATCHERY.

The Brookdale Hatchery was closed about the middle of July after completing a very successful season. Most of the steelhead trout eggs collected at Scott Creek Station and "eyed" at Brookdale Hatchery were shipped to the Mount Shasta Hatchery, but approximately 900,000 were hatched out at Brookdale and distributed in the streams of Santa Clara and Santa Cruz counties.

ALMANOR HATCHERY.

The half million rainbow trout eggs hatched at Almanor Hatchery were distributed during the month of July in the streams of Lassen County and tributaries of Lake Almanor, Plumas County. The hatchery was closed and the crew was transferred to the Domingo Springs Station on Rice Creek, Plumas County.

DOMINGO SPRINGS STATION.

The take of rainbow trout eggs at Domingo Springs Station amounted to 850,000. A portion of them were shipped to the Mount Shasta and Fort Seward hatcheries, and the remainder were hatched and distributed in some of the lakes and streams of Plumas and Lassen counties. The crew is at present engaged in making repairs and improvements to the racks, traps, and living quarters of the assistants. The eyeing station is being moved to a more desirable location where a better supply of water from Rice Creek may be obtained.

BEAR LAKE HATCHERY.

The Bear Lake Hatchery was closed August 25, after completing a very successful season. The 875,000 rainbow trout fry hatched at the station this season were given a wide distribution in the streams of San Bernardino County and in Big Bear Lake. The commission is planning to increase the size of the egg collecting and eyeing station at Bear Lake this fall, and if a lease can be obtained from the heirs of the North estate (on whose property the station is located) for a term of years, the new station will

be constructed before the winter storms set in. It is planned to construct a 48-trough eyeing station and suitable living quarters for the employees. With adequate facilities for collecting and "eyeing" the eggs, it is expected that a large number of rainbow trout eggs will be taken from Bear Lake next season.

TAHOE HATCHERIES.

Egg collecting operations at the Tallac Station this season were very successful, 4,250,000 black-spotted eggs being taken. Of this number 1,000,000 were shipped to Mount Shasta Hatchery, 250,000 to Mount Whitney Hatchery, 775,000 were transferred to the hatchery at Tahoe City, and the balance were hatched at the Tallac Hatchery. The resulting fry were given a wide distribution in streams of El Dorado County and in streams tributary to Lake Tahoe in El Dorado and Placer counties. The eggs shipped to the hatchery at Tahoe City were hatched and the fry are now being distributed in the streams of Placer and Nevada counties. A shipment of 250,000 rainbow trout eggs was made from the Domingo Springs

Station to the Tahoe City Hatchery, and the resulting fry will be distributed in streams and lakes in the vicinity of Lake Tahoe and in the Truckee River.

WAWONA HATCHERY.

Wawona Hatchery was opened for operations during the fore part of May and 75,000 steelhead and 150,000 rainbow eggs were shipped to the station from the Snow Mountain and Mount Shasta hatcheries. The resulting fry were distributed in the streams of the Yosemite Valley during the latter part of July and the fore part of August. The station was closed on August 18.

MOUNT SHASTA HATCHERY.

The two fish distribution cars have been busily engaged in the work of distributing the fish from the Mount Shasta Hatchery, and it is expected this work will be continued well into the month of October. Approximately 10,000,000 trout fry will be distributed from Mount Shasta Hatchery in the streams of California this season. After the completion of the trout distribution work, the quinnat



Fig. 73. Spawning trout in Bear Lake, San Bernardino County, California.
Photograph by Messrs. Willard and Pierce.

salmon, which are being retained in the large rearing ponds and lakes, will be distributed in the upper reaches of the Sacramento and Klamath rivers.

MOUNT WHITNEY HATCHERY.

On September 23 distribution car No. 01 will be detached from the Mount Shasta Hatchery distribution work, and will be sent to Mount Whitney Hatchery to commence the distribution of the trout fry from that station. The 250,000 black-spotted and 750,000 steelhead trout eggs which were shipped to Mount Whitney Hatchery early in the season have hatched, and the resulting fry are exceptionally strong and healthy. Four hundred fifty thousand rainbow trout eggs were taken at the Rae Lakes Station, an auxiliary station to Mount Whitney Hatchery, and were transported by pack animal to the hatchery. It was not until very late in the season that the spawning crew was able to get into the Rae Lakes section to open up the station, owing to the heavy fall of snow which blocked the Oak Creek Pass. The take of eggs was therefore very light, as a considerable percentage of the fish had already spawned.

As soon as the distribution car arrives at the Mount Whitney Hatchery, distribution operations will be commenced. The fish will be shipped to applicants of southern California and of lower San Joaquin Valley counties.

SCREEN AND FISHWAY INVESTIGATION.

During the past three months, the screen surveyor has been engaged in making new surveys of all the canals and ditches in the counties of Butte, Contra Costa, Fresno, Kings, Lassen, Madera, Mariposa, Merced, Modoc, Shasta, and portions of Siskiyou, Stanislaus, Tehama and Tulare counties, and preparing notices to be served on the owners of the same to install suitable screens in accordance with the new law passed at the last session of the legislature.

The ladder surveyor has made a number of surveys and prepared plans for fish ladders to be installed over dams in the counties of San Luis Obispo, El Dorado, San Mateo, Napa, Shasta and Butte. The fish ladder over the Alta Bert Dam, property of the Trinity County Water and Power Company, in Trinity County, was completed during the month of August.

COMMERCIAL FISHERY NOTES.

N. B. SCOFIELD, Editor.

CALIFORNIA'S COMMERCIAL FISHERIES.

Commercial fisheries of California are enjoying general prosperity and it is now certain that the catch for 1917 will reach 200,000,000 pounds, which is about double that of 1916. The salmon catch has not come up to expectations, but the tuna catch will be about double, and with the present high prices the pack will have a wholesale value of over \$5,000,000.

The greatest development has been in the sardine fishery. The tuna packers of southern California last winter took up the canning of sardines as a side line to keep their canneries busy. On account of the long fishing season and the low cost at which sardines can be obtained, there is more profit in canning sardines than tuna. During the first six months of 1917 over 600,000 cases of sardines were packed and, as the last six

months of the year are usually the best, the pack should reach 1,000,000 cases, with a wholesale value of \$7,000,000.

Ours is a true sardine, and if properly packed is the equal of any, even the celebrated French sardine. So far the larger fish have been canned to the greatest extent, although a few canneries put up the smaller fish in olive oil in $\frac{1}{2}$ -pound cans. These compare favorably with the best imported article.

The sardine packers of this state are alive to the fact that the industry is still in its infancy and that within a few years the pack can be increased to 3,000,000 cases. In order that the industry may be built up solidly on its merits and on the quality of the pack, the packers are endeavoring to form an organization along the lines of an association formed by the sardine packers of Maine, when it became necessary to put out a better quality

and a more uniform pack to save themselves from financial ruin. The proposed organization will have a system of inspection so that only prime fish will be packed and rigid sanitary rules will be enforced about the canneries and in handling the fish on the boats. On September 14 a delegation of sardine packers from southern California visited Monterey in a special car, the object in view being to look over the canneries and fishing methods of that section where the packers have had more years of experience. It was also their idea to complete the plans for the new organization, which they propose to make state-wide.

Several companies largely interested in fisheries in both the United States and Alaska have recently been investigating the sardine and tuna possibilities in this state, and it is certain that the next year will see some of them actively engaged in the business in California. Monterey Bay now has six sardine canneries, and it is very likely that this number will be increased in the near future. Two companies have already made application to the Monterey city council for water front space for canneries. According to a local paper, it is believed that large interests are behind the applications. One is said to be Libby, McNeil & Libby and the other the Alaska Packers.

All indications point toward a most wonderful development in the California fisheries for the year 1918.

COMMERCIAL FISHERIES ON THE MENDOCINO COAST.

Within the last year a cannery and two mild curing plants have been established at Noyo, Mendocino County, a mile and a half south of Fort Bragg, which is the shipping point, and if the proper steps are taken toward securing a navigable entrance to the Noyo River several more plants will be established at this point. There seems to be no question as to the supply of fish, and with a proper harbor for fishing boats, Noyo and vicinity will excel Monterey, particularly for salmon, according to fishermen now in this territory.

Up to within a year ago Noyo was practically unknown in so far as commercial fishing was concerned. Because this territory is new to most fishermen and on account of the poor entrance to the harbor the maximum number of boats there this year was only 100, but upon interviewing fishermen working in these waters it was learned that they all intend to return, and predict that double the number of boats will come for the 1918 season.

Shelter Cove, about forty miles up the coast from Noyo, is a very good fishing ground and a fair shelter for the boats during all weather conditions, except a southeaster. Freight boats carry the fishermen's catch to Noyo and return with provisions, gasoline, etc., and because of these boats plying between the fishing



Fig. 74. Fish cannery on Noyo River. New fishing grounds near the mouth of the Noyo River are increasing the fish industry in this vicinity. Photograph by H. O. Beckley.

ground and Noyo the fishermen can remain on the fishing ground constantly, or as long as they choose.

F. D. Small and D. C. Urie, both from Tillamook, Oregon, under the firm name of Small & Urie, have invested about \$15,000 in a salmon cannery at Noyo and are equipped to handle 550 cases (maximum capacity) of salmon per day. At the present time they employ twenty-five people and could use a much larger force if they could get the fish, but because of the lack of fishing boats this cannery has never run to its full capacity. The run of salmon begins the latter part of June and ends the latter part of August, and from 600 to 1,000 pounds per boat in a day's fishing is not an unusual catch. This season one boat with two men caught 1,490 pounds in a single day's fishing. The price ranges from 6 cents to 9 cents per pound.

There are also two mild curing plants at Noyo. One, the Columbian Northern Fishing and Packing Company, with F. Klevenhusen of Altoona, Washington, for its president, represents an investment of about \$12,000, and has a cold storage capacity of 125 tons. They manufacture their own ice and have a maximum capacity of 1,000 tierces per season. This plant does not operate any boats of its own and must depend upon outside fishermen for its supply. The Pacific Mild Cure Company of San Francisco has a

plant here, but its pack was small this season, due mainly to lack of boats.

There were approximately 200 tons of salmon shipped from this territory fresh, beside that which was used by the cannery and the mild curing plants.

JAPAN FURNISHES FISH FOR ARMY.

Japan is furnishing Russia with fish for the use of her army. For the period of one year, from March, 1917, to March, 1918, it is estimated Russia will require 29,000,000 pounds of preserved fish, other than canned fish, in the following proportions:

15,000,000	pounds salted
9,500,000	pounds dried
4,500,000	pounds frozen

The Japanese salmon fisheries in Japan and Kamchatka have had a very prosperous season, and they are expecting to sell large quantities of canned salmon to England. The Japanese are evidently finding a very active market for their salmon for the price of salted salmon in the Hakodoti market has within a year risen from 12 pounds for 1 yen to 3 pounds for 1 yen, one yen being about 50 cents.

USE OF FISH BY OUR ARMY ADVOCATED.

"National Army to Be Well Fed" was the caption in one of the evening newspapers on Thursday, and in reading the list of foods to be furnished our soldiers

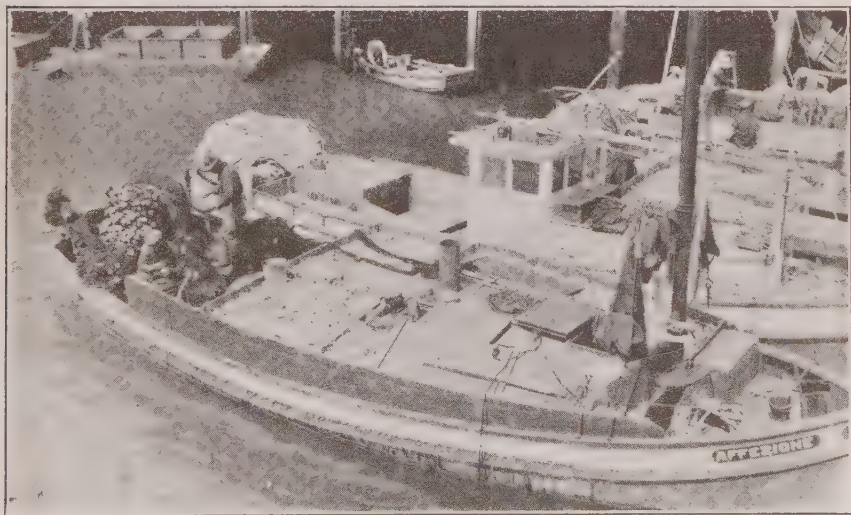


Fig. 75. Fishing boats loaded with sardines, San Pedro, California, August, 1917. Photograph by W. F. Thompson.

while in camp one is tempted to believe that in the matter of serving the inner man their wants will be taken care of as well or even better than if they were in their own homes. Apparently only one thing is lacking from the schedule prepared for ten days—and that is fish. With the government continually advocating the greater use of fish in order to conserve the meat supply, it is only natural to suppose that the commissary department of the United States army would pay some attention to the question of fish, particularly when it is generally known that Great Britain has purchased 14,000,000 pounds to be supplied by the United States.—*The Fishing Gazette*.

"EAT MORE FISH."

Under the heading "Eat More Fish" the Bureau of Fisheries sends out the following poster:

Fish is meat and has a high food value.

Analysis shows that fish meat contains as much body-building food as beefsteak.

Experiments show that fish is as readily digested as other meats.

You could replace all other meats with fish every day in the year without ill effects. There are more possibilities of increase in the meat supply by the fisheries than by any other one industry. The demand in the past has not equaled the supply.

Eat fresh fish if you are near the source of fresh fish, but don't expect to buy at a low price fresh fish that have to be shipped by express for long distances on ice. Consume your locally-caught fishes and don't all use the same kinds. The cheapest is often as good as or better than the dear.

Eat salt fish wherever you are. Write the Bureau of Fisheries for recipes for preparing salt fish for the table. If you eat meat for breakfast make it salt herring, salt mackerel, or other salt fish. Salt fish are good eating if you prepare them properly for the table. Do that.

Eat smoked fish. There is nothing better than fish prepared by this old-fashioned method. Smoked herring, smoked eels, smoked bowfin, smoked shark, smoked carp. The three last mentioned are just being introduced to the market. Make them go. Write for recipes for preparing smoked fish for the table.

Don't let Friday be the only fish day. Eat more fish more days a week.

Don't stand back on disagreeable names or ungainly appearances.

Prejudice is an expensive luxury. A shark would not taste any better if called by another name; it tastes good, as it is. Carp is good eating and nutritious. You will not find any fish on the market that is not fit to eat if it is in good condition. The best test of a good fish is not its name, but its freshness.

Look out for new fish. They are coming. Bowfin, grayfish, burbot, goosefish, shark, skate, sablefish, grouper.

Preserve fish in the home. Small-pressure canners are already in use by thousands of people. Put up a supply of fish when you can get them cheap. Can the roes, too; they are especially nutritious.

Eat fish—cultivate the taste—get the habit.

PRESERVING FISH WITHOUT ICE.

In the *Canadian Fisherman* for July, 1917, appears the following article on "Sherman's Method" of preserving fresh fish, which should be of interest to dealers in the present movement to increase the consumption of fish:

"PRESERVING FISH WITHOUT ICE OPPORTUNITY FOR THE SMALL PRODUCER.

"Sherman's Fish Sterilizing Company, Ltd., 1416 Standard Bank building, Vancouver, B. C., is the owner of the Henderson process for preserving fish without ice.

"A. H. Sherman, proprietor of the Defiance Packing Company, is the Britisher who introduced this process into Canada, being impressed with its importance from the fact that the Board of Agriculture and Fisheries, 43 Parliament street, London, England, reported in February, 1917, that 'there appears to be no ground for doubting Mr. Henderson's claim as to the practicability of the process on a commercial scale.' When a British government board puts its seal of approval on a fish preserving process it is good enough for all Britishers, is Mr. Sherman's opinion.

"Many tests with an experimental plant have been carried out in Vancouver, and their results have been satisfactory to all concerned. After a recent test, Mr. Sherman received the following unsolicited testimonial from Edward G. Taylor, inspector of Dominion fisheries, Nanaimo, B. C.:

"The test proved entirely successful and the process was exceedingly simple, and no ice was used at any time during the process. I also ate salmon which had

gone through the process, and had been out of the water for fourteen days, and this salmon was just as fresh and firm as if it had been taken out of the water that very day. The bone of the salmon was strong, sound and sweet, proving conclusively that the process was entirely successful in preserving fish without ice for at least fourteen days, and from what I have seen, I have no doubt it would keep a very much longer time. I believe the process will be a great boon to the country and be an immense factor in the development of the fishing industry.'

"Some of the processed fish was expressed to W. A. Found, Department of Naval Service, Dominion Fisheries, Ottawa, and he wrote after sampling it: 'There was nothing in the taste of either fish that suggested to me that they had not been cured immediately following their being landed.'

"It is claimed by the owners of this patented process for preserving fish without ice that because no ice is needed the cost of preservation is lessened, and therefore, the fish can be sold cheaper.

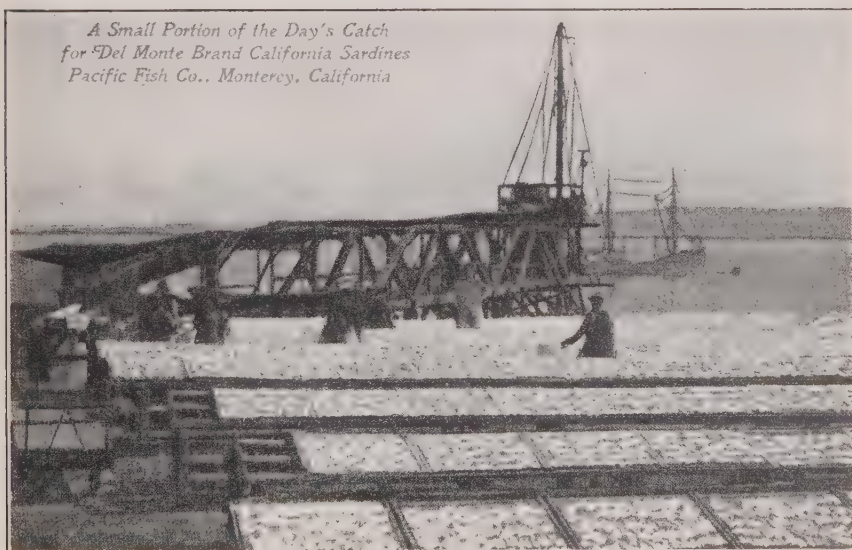
"All the original flavor of the fish is maintained. The process applies to fresh and smoked fish, and also to meats, with which successful tests have already been made.

"The whole process from start to finish takes only three hours. Salt, low tem-

peratures and sterilization are salient features of the process. First the fish is put into a cooling tank filled with water and brought to a low temperature. In half an hour the latent heat in the fish is extracted gradually and entirely. Then the fish is put into a second tank of sea water or fresh water strengthened by the addition of salt. In order to prevent freezing the water is agitated by a pump which draws it off through one pipe and drives it back again through another, passing through a filtering chamber charged with willow charcoal to kill the germs. The extremely low temperature of the salt solution seals up the pores of the fish and prevents saturation, acting as an antiseptic protection on the outside. After three hours the fish is taken out and presents a fresh appearance. It is impervious to decay for ten days, and may be kept in a cool room for months.

"Robert Mann, superintendent of the Henderson Process Plant at Dock street, Fleetwood, England, who installed the first plant at Lisbon, Portugal, writing under date of February 28, 1917, of the process of the Fleetwood plant says:

"I can not speak too highly of the great success of this plant. Treated fish kept in excellent condition for a fortnight or longer in changing weather, the flavor being equal to that of newly caught fish; it never becomes flabby as in the



*A Small Portion of the Day's Catch
for 'Del Monte Brand California Sardines'
Pacific Fish Co., Monterey, California*

Fig 76. Part of a day's catch of sardines at Monterey, California.

case of fish that has been on ice. It is also admirably adapted for use in connection with smoked fish being first treated and then smoked. It keeps for a much longer time, especially in hot weather, and has a better flavor.'

"Mr. Sherman sees great possibilities in this process, for it is cheap to install and it will give the small producer of fish a means of preserving his catch so that he may reach the distant markets with his fish in good condition. He considers this process will not antagonize the cold storage companies, but will supplement the work they are doing in increasing the production of fish."

MISCELLANEOUS BRINE-SALTING.

All along the Atlantic coast of the United States a small local business is carried on in pickling fish for use during the winter in the homes of fishermen and their neighbors. Among the species thus

prepared are bluefish, squeteague or sea trout, channel bass, croakers, perch, sheepshead, Spanish mackerel, striped bass, black bass, hogfish, etc. There is no uniform method of pickling, the fish being dressed, salted and packed according to the fancies and convenience of the curers, and the product rarely goes on the general market. In general, the fish are dressed by removing the head and viscera, and are split down the back or sometimes the belly, so as to lie out flat. They are next washed and soaked until the blood is removed and then covered with salt and placed in barrels, first a sprinkling of salt and then a layer of fish, and so on until the barrel is filled. Then brine is poured in to fill the interstices and the barrel is headed and coopered.—From "The Preservation of Fishery Products for Food," by C. H. Stevenson, in *The Bulletin of the U. S. Fish Commission*, for 1898, pp. 464-465.

UNITED STATES FOREST SERVICE COOPERATION.

MOUNTAIN LIONS KILL DEER.

During 1916, four deer were reported as being found in the Sierra National Forest which had been killed by mountain lions.

One cowman, while riding after cattle, saw a lion carrying a spotted fawn, so gave chase for about a mile. At one time he got as close as twenty feet from the lion, but still he stayed with the fawn, even though its feet were dragging on the ground, and the lion would occasionally stop on them as he ran.

Last October this same cowman killed a black bear that weighed about 600 pounds, from which he fried out 40 pounds of lard.—C. E. JORDAN.

CLEVELAND GAME REFUGE.

The Cleveland game refuge has shown the advantage of a protected area. The number of deer killed along the edge of the refuge was double the amount killed for the past several years.

The long open season on doves and quail is proving disastrous to the birds, especially the doves. The early shooting in September finds about 15 per cent of the doves still nesting. The largest part of the birds killed are half grown and full of pin feathers. What old birds that are killed are usually poor and many show

signs of still nesting. In the early part of September I have found as high as ten doves still on the nest.

The logical thing to do is to combine the dove and quail season and not have over two months to hunt.

It is often claimed that the doves leave the open country early. They do, but they come back in November and December. The birds are then fat and full-grown.—J. B. STEPHENSON.

MOUNTAIN SHEEP AT HEAD OF KERN RIVER.

A band of mountain sheep range on the Kaweah Peaks, to the north and east of the Big Arroyo, in the Sequoia National Forest. Stockmen, who have been grazing their cattle in that vicinity for several years, believe there is a decided increase in the band, judging by the number of tracks observed.

These sheep are very wild. They stay in the rough country and are seldom seen. Thomas Smith, a stockman, reports seeing one late in the fall near Kennedy Meadows, on the south fork of Kern River, and it is believed that some of the band that spends the summer in the high peaks near the head of Kern River winter on the south slope of Olancha Peak and the Kennedy Meadows country.—F. P. CUNNINGHAM.

REPORTS.

NUMBER OF DEER KILLED IN VARIOUS COUNTIES DURING THE OPEN SEASONS, 1914-1916.

District No. 1.

County	1914	1915	1916
Alpine	39	66	170
Amador	36	43	64
Butte	39	26	130
Calaveras	202	111	179
Del Norte	*	1225	1250
El Dorado	300	109	82
Fresno	151	156	115
Humboldt	200	167	1300
Inyo	40	1131	54
Kern	235	121	375
Kings	14	1	31
Lassen	89	126	87
Madera	57	34	104
Mariposa	53	10	38
Merced	†	*	*
Modoc	160	106	106
Mono	152	4	6
Nevada	143	65	75
Placer	77	87	50
Plumas	200	93	276
Sacramento	30	*	*
San Joaquin	8	*	*
Shasta	357	492	425
Sierra	37	11	45
Siskiyou	575	665	378
Stanislaus	†	51	36
Sutter	*	*	*
Tehama	198	164	258
Trinity	735	543	508
Tulare	128	223	285
Tuolumne	203	174	311
Yuba	6	14	*
Totals	4,464	4,028	4,538

District No. 2.

Colusa	250	262	233
Glenn	90	215	170
Lake	161	84	193
Marin	370	1325	194
Mendocino	268	1500	350
Solano	14	5	*
Sonoma	436	360	131
Yolo	38	127	61
Napa	373	119	163
Totals	1,950	1,997	1,495

District No. 3.

County	1914	1915	1916
Alameda	8	‡125	‡125
Contra Costa	*	†	175
Monterey	632	595	91
San Benito	11	55	50
San Francisco	No	hunting	*
San Luis Obispo	60	155	167
San Mateo	5	55	150
Santa Clara	5	362	401
Santa Cruz	155	‡132	124
Totals	876	1,479	1,283

District No. 4.

Imperial	*	*	5
Los Angeles	143	95	153
Orange	24	*	20
Riverside	102	55	45
San Diego	45	44	35
San Bernardino	97	29	60
Santa Barbara	475	338	270
Ventura	*	172	213
Totals	886	733	801

Reports Unspecified as to Counties.

Shasta National Forest	87		
Lassen National Forest	13		
California National Forest	238		
Stanislaus National Forest	96		
Santa Barbara National Forest	89		
Sierra National Forest		106	
Totals	523	106	
Total for year 1914	8,699		
Total for year 1915		8,343	
Total for year 1916			8,117

*No record.

†Closed season.

‡Estimated.

CALIFORNIA FISHERY PRODUCTS FOR APRIL, MAY AND JUNE, 1917.

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Sacramento, San Joaquin	Alameda, Contra Costa	San Francisco, San Mateo	Santa Cruz	Monterey	San Luis Obispo, Santa Bar- bara, Ventura	Los Angeles	Orange	San Diego	Mexico	Total
Albacore							18,505		35,885		2,038,908		523,689		2,562,597
Anchovy			6,428								13,977				68,268
Baracuda									255	4,500	1,161,773	8,060	172,214	14,998	1,485,500
Bonito									20,751		3,092		335		50,499
Bocaccio							29,688								3,427
Buafish							57,349								3,319
Chillipepper							113,637		2,540						16,227
Carp				13,008	16,273	20,124	13,836								63,241
Catfish		10,033		30,504	32,346	26,427									101,900
Sablefish							321,170	19,500	43						348,983
Cultus cod							77,480	29,038	21,243	800					131,237
Dogfish						2,933	17,280				5,385				26,207
Flounder						102,613	374,597	11,310	54		150	515	696		492,161
Halibut			47	377	1,374		14,680	3,220	3,949	54,455	398,575	16,020	169,891	489,920	1,254,888
Hake			101				16,400	15,300			947		11		32,058
Herring									8,460		1,010				359,080
Kingfish			349,619				18,812	14,415	79,317	2,000	165,630	800	7,135		288,130
Mackerel									1,927	1,200	304,516	2,200	602,222		911,835
Mullet													432		9,972
Pike							9,840								2,791
Pompano						404									21,416
Perch			8,859			171	7,210	5,530	1,084		11,757		835		42,314
Rock bass															
Rockfish		2,595					132,737	52,211	158,146	8,930	54,141	1,985	114,983		170,412
Sole			761			60	933,027	421,015	5,295	1,000	635,571	7,168	214,737	80	1,222,310
Salmon				146,107	175,653	478,265	51,347	220,120	2,867,383	1,000	8,537				1,938,931
Smelt			4,293			1,030	50,097	11,532	7,993	25,695	10,292				3,954,251
Sea bass (white)							81		122				7,225		188,614
Sea bass (black)							63			2,000	356,499	5,100	26,762		390,594
Sandab			35				532,670	223,023	1,882	1,890	259		52,657	34,750	91,152
Striped bass			1,395			128,155	135,359		153	1,000	4,139	865			768,679
Shad						3,277,642	26,704								445,011
Sturgeon				537		1,766									5,272,631
Sardine						3,816	208								26,474,429
									3,580,680		22,262,175				

CALIFORNIA FISHERY PRODUCTS FOR APRIL, MAY AND JUNE, 1917—Continued.

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Sacramento, San Joaquin	Alameda, Contra Costa	San Francisco, San Mateo	Santa Cruz	Monterey	San Luis Obispo, Santa Bar- bara, Ventura	Los Angeles	Orange	San Diego	Mexico	Total
Skate							52,453	150			2,060				51,833
Sculpin							5				5,789				5,794
Sea trout											769	500	988		2,237
Tom cod							3,503				8,770				12,273
Turbot			236												236
Whitebait			1,251				69,245	65							71,106
Yellowtail		545							3,974	250	245,630		9,441		232,353
Stingray		7,741	47,120	1,730	1,815		2,300	5,731	40		20,717		2,945	6,911	47,120
Miscellaneous	1,422														46,091
Total fish	33,609	95,163	420,171	1,436,004	1,136,522	4,041,993	3,224,121	1,051,370	6,803,494	144,819	27,756,488	44,713	2,539,447	549,889	49,334,930
Crustaceans—															
Crab (dozen)	5,084	125					13,778	2,927	274		2,431		17		*533,144
Spiny lobster													8,160		167,904
Shrimp							125,714								125,714
Ecrevisse		70													70
Totals															826,832
Mollusks—															
Squid															
Cuttlefish			48						235,724		45,294		635		281,638
Clam (Pismo)							1,975	3,051	2,855						7,229
Clam (cockle)								985		71,531					72,516
Clam (soft-shell)	14,700	3,588	12,492							560	11,736				94,728
Clam (mixed)			175,293												215,239
Oyster (shell)			2,190				45								4,793
Abalone		6,733	2,283				1,075,200			1,449		1,100			1,077,433
Mussels	4,200	1,933							216,859	10,883					237,458
Cal. oysters			21,882						2,010	2,153	15,265				233,019
Bay mussels			294				485								21,882
Totals															2,208,403

*Crab are estimated at 24 pounds to dozen.

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